ENERGY CONSERVATION HANDBOOK

RURAL ELECTRIFICATION ADMINISTRATION
REA
U.S. DEPARTMENT OF AGRICULTURE

INTRODUCTION

This Handbook was prepared by REA to aid electric cooperatives in planning and conducting their energy conservation program. It is not designed as a training manual, but rather as a source book of information that can be reproduced in total or in part for the members of the cooperative.

The items in the Handbook were chosen after a careful review of materials from many sources, including Federal and State agencies, universities, rural electric cooperatives and other utilities.

Although the users of the Handbook may detect different viewpoints between publications, they can pick and choose material most applicable to local circumstances.

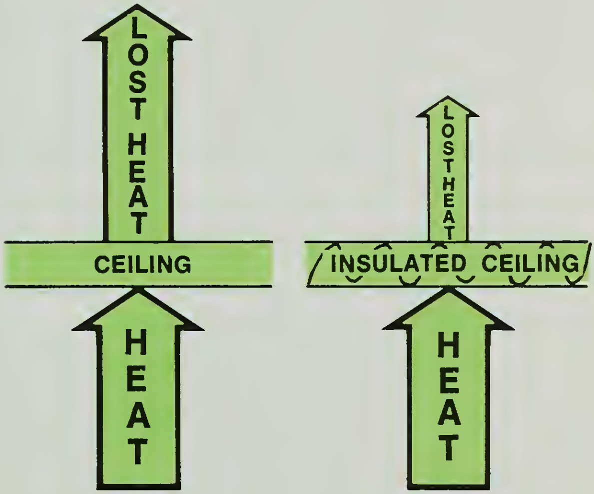
REA will continue to provide conservation materials for inclusion in the Handbook.

INSTALLING HOME INSULATION

A HANDYMAN'S GUIDE

Why Insulate At All?

Insulation controls the flow of heat. It keeps heat **inside** your home in winter and **outside** your home in summer. This helps to reduce your heating bills in winter and your cooling bills in summer. It saves you money year-round. It provides a more comfortable home. And it helps to conserve our nation's dwindling energy reserves.



How Much Can I Save?

Assume that you have an electrically heated 1,500-square-foot house in a 3,500 degree day area, such as Chattanooga or Knoxville, *without* insulation in the ceiling or under the floor. Ceiling insulation properly installed, would save about 17,500 kilowatthours (kWh) during a normal heating season. Multiply this by the average rate per kWh in your area and you will see that the savings would be enough to pay for the cost of the insulation in one year. These savings would continue as long as you live in this house. Installing 3 or more inches of insulation under the floor would save about 5,000 more kWh

annually. Moreover, if your house is air-conditioned, the six or more inches you've installed over the ceiling will save you more than 1,500 kWh each summer.

How Insulation Works

Insulation is any material that provides a high resistance to the flow of heat from one area to another. Most commonly used in homes are the fibrous insulations (mineral wool, glass wool, or cellulose fiber), which are light and very porous. Containing millions of tiny air pockets, they are highly effective in slowing heat flow. Loose-fill insulation is often used for blowing or pouring over the ceiling.

Where The Heat Goes

In a completely uninsulated frame house, with no storm windows or storm doors, the heat lost through the various portions of the building is as follows. We have assumed that 15 percent of the outside wall area is made up of windows and doors, and that the infiltration rate is one air-change each hour. (Infiltration is unavoidable air leakage in a normal house, coming through cracks in walls, from around doors and windows, and through open doors and windows.)

	Heat Loss
Ceiling area	45%
Floor area	20%
Windows and doors	12%
Outside walls	12%
Infiltration	11%
Total	100%

These percentages **will** vary with the amount of window area, floor plan, number of people in the family, age of the home, and other factors. They are only average for the typical noninsulated 1,500-square-foot house.

Effectiveness and "R" Value

The ability of insulation to slow the transfer of heat is not only determined by its thickness but also by its density, weight, and other factors. The effectiveness of insulation is measured in Resistance or "R" value. This R-value is marked on all insulation you buy, whether it is in batt, blanket, rigid board, or loose-fill form. In the case of loose-fill insulation, the label on the bag will show the minimum thickness necessary and the maximum number of square feet the contents of the bag will cover to give the desired R-value.

Higher R-values may be justified as the cost of energy increases. However, here are the presently recommended minimum "R" values for homes in the TVA area:

Ceilings	R-19
Outside walls	R-11
Floors	R-11

Doing it Yourself

In doing the job yourself, there are a few precautions you should take. Handling insulation can temporarily irritate your skin, so keep your shirt sleeves rolled down and buttoned, and wear a pair of work gloves.

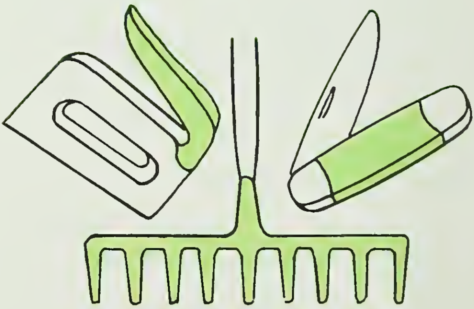
If you're using loose-fill, cover your nose and mouth with a piece of gauze or a handkerchief to avoid breathing flying dust.

Don't attempt to work in the attic on a hot sunny day when temperatures can reach 140 degrees. Work in the morning or on a cool, cloudy day.

Finally, watch out for any nails that stick through the roof sheathing above your head.

After you have finished the job, take a cold shower. The cold water closes your pores and washes off the insulation, preventing it from getting into the skin.

Some Tools You'll Need



1. A sharp knife or serrated kitchen knife to cut blankets or batts. A long pair of scissors will work equally well.

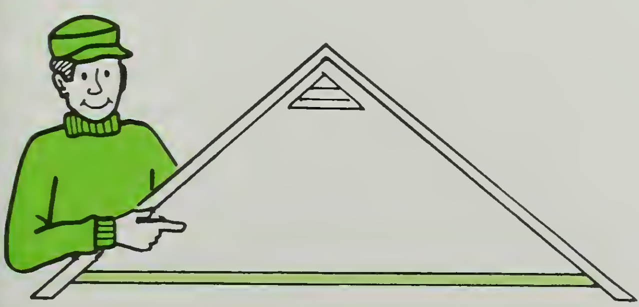
2. A straight edge to cut along. A length of board will do the trick.
3. A rake to spread out loose-fill insulation or to push or pull blankets or batts to edge of the eaves.
4. Walk boards. When in the attic, don't step between the joists or your foot will go through the ceiling. Use a strong plank or board to lay across the joists to walk on.
5. Lighting. If your attic isn't lighted or there are no windows, get a portable light with plenty of extension cord.
6. A staple gun.

Which Should Be First?

The ceiling. As you will notice from the previous table, by far the greatest percentage of heat loss is through the ceiling. It goes eleven times faster through a ceiling that has no insulation than one that is fully insulated (R-19).

An inspection of your attic will probably reveal one of the following conditions:

1. No insulation (in many older homes).
2. Some insulation, but settled to only 2-3 inches, and in some places, little or none.



In either case, it will pay you to insulate to at least R-19. (If you're using loose-fill, check the bag label for the proper depth.)

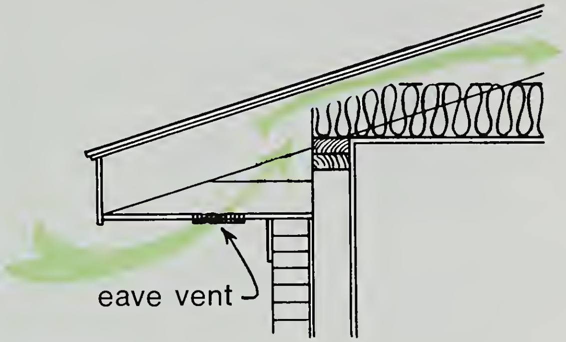
Insulating The Ceiling That Has No Insulation

Using batts or blankets. Use insulation with an R-value of 19 or higher. Lay the insulation between the joists with the vapor barrier **facing down** toward the heated (in winter) rooms below. It's best to start from the outer edges of the

attic and work toward the center. This allows you to do any cutting or fitting together in the center where there is more headroom.

You need not staple the insulation between the joists, just push it down to the ceiling, smoothing out the vapor barrier against the ceiling and joists. Where cross-bracing prevents you from getting the batt down to the ceiling, cut the batt and fit it as tightly as possible above and below the bracing. The adjacent

insulation should be fitted in the same manner.



Cover the ceiling as close to the eaves as possible, but . . .

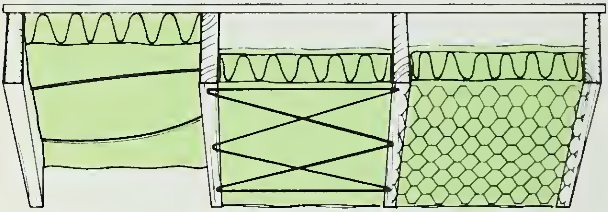
- Do not cover eave vents or block venting space along the eave of the roof.
- Do not cover recessed lighting fixtures or exhaust fan motors.
- Do not overlook any areas where there are heated areas below.
- Do staple or tack insulation to the hatch leading into the attic area.

Using loose-fill insulation. The R-value of different manufacturers' loose-fill varies considerably per inch of thickness. Check the label on the bag to find out how many bags to buy and how thick to pour it to get an R-value of 19. The label will show the thickness in inches required to obtain R-19 and the number of square feet the contents will cover at that thickness.

In calculating the number of bags that you will need, remember that the joists take up about 10 percent of the attic area. So multiply the attic area by 0.9 to find the number of square feet you will

Choose batts or blankets with a vapor barrier and an R-value of 11, usually 3-3½ inches thick.

Push the blankets up between the floor joists from below with the vapor barrier **facing up** toward the room above, which is heated in winter. They can be held in place as shown below.



Wire staves bowed between joists.

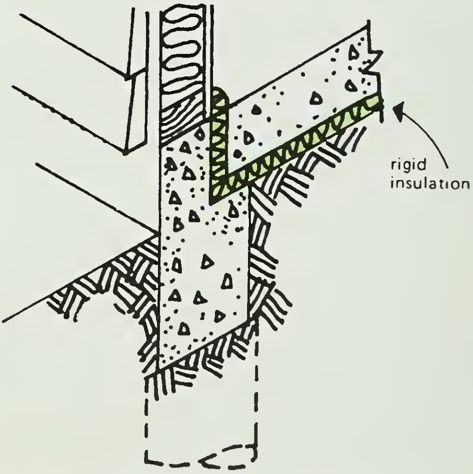
Wire laced back and forth around nails.

Chicken wire stapled across the joists.

The above supplies can be purchased at most hardware, building supply, or farm supply stores.

Insulating A Concrete Slab

Most of the heat that is lost from a concrete floor is through its outer edges.



If you're adding a room on a concrete slab, be sure to have your contractor install two inches of rigid insulation around

the outside perimeter when he pours the concrete.

Insulating Walls

Insulating finished outside walls in an existing home isn't recommended for the do-it-yourselfer. Leave this job for the experienced insulation contractor.

However, there are certain areas in which you can install insulation in a wall very easily.

1. Garage walls adjacent to heated living areas. (Vapor barrier faces heated side of wall.)
2. Basement walls when you're making it into a den or playroom.
3. Exterior walls when you're adding another room or finishing off a room in the attic.

Use blanket insulation marked R-11 in stud walls, either with or without a vapor barrier. If you buy it with a vapor barrier attached, start at the ceiling level and push the insulation between the studs and staple the top end of the vapor barrier to the top framing. (You may find it easier to cut an inch or two of the insulation away from the vapor barrier, leaving the vapor barrier free for use as a stapling flange for attaching to the top and bottom boards.)

Next, staple the flange to the face of one stud about eight inches below where you stapled the top. Pull the vapor barrier tightly across and staple the flange to face of the opposite stud. Repeat this all the way down the two studs, stapling about eight inches apart, keeping the vapor barrier and stapling flanges as tight and smooth as possible. Staple the bottom end of the vapor barrier to the bottom framing. (Any gaps between the stud and the stapling flange will allow moisture vapor to penetrate into the insulation.) Tape up any tears or holes you may have accidentally made in the vapor barrier.

Insulate odd-shaped spaces, such as around window and door frames, by cutting pieces of insulation to fit and cover with a vapor barrier. Stuff pieces of insulation behind electrical outlets and switches. Insulation should be placed behind water pipes in outside walls to prevent them from freezing.

Wall insulation which does not have an attached vapor barrier (friction fit) is available in many stores. It's slightly wider than the space between the studs and holds itself in place by friction, without any need for stapling. However, a vapor barrier **must** be applied after

the insulation is in place. This can be done very easily by stapling 4-mil polyethylene plastic film to the studs on the warm wall side over the entire wall area, then cutting out the window and door areas and around electrical outlets, after you have stapled it in place.

When insulating basement masonry walls, 2″ by 2″ furring strips are fastened vertically to the wall. Distance is 16″ or 24″ from the center of one strip to the center of the next. Use R-7 insulation with the vapor barrier facing the warm side of the room. Staple the insulation flanges to the face of the furring strips in the same way you would in insulating a stud wall.

Insulating Ducts

In many older homes, the uninsulated ductwork for the central warm air furnace runs through the cold attic or crawl space. The rate of heat loss through these bare ducts is very high. Both the supply and return ducts, whether rectangular or circular, should be wrapped with 2 inches of standard duct insulation with the vapor barrier on the outside.

The vapor barrier should be lapped a minimum of 2 inches over each joint. All joints should be securely stapled and sealed with duct tape. The insulation should fit snugly, but should not be pulled so tightly that it becomes compressed.

Other Energy Savers

Storm doors and windows will pay for themselves in several years and will make your home more comfortable. They eliminate most of the drafts and will help keep your windows from sweating in very cold weather.

If you don't wish to install regular storm windows, you can accomplish almost the same purpose easily, effectively, and at very little cost with clear plastic storm windows, available in kits or rolls. The plastic sheet is merely stapled or tacked onto the outside of the wooden window framing, covering the entire window, creating a dead-air space between it and the glass. Installation instructions are supplied with the kit.

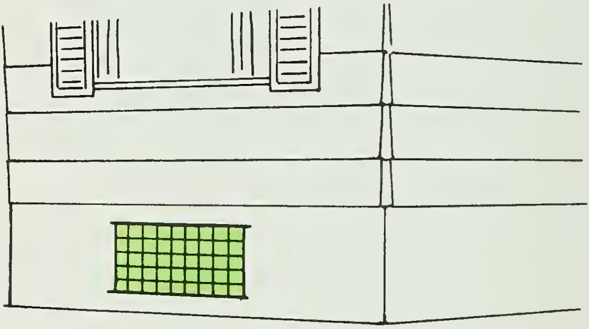
If you have aluminum windows where it is impossible to staple or tack the plastic, consider **taping** the plastic inside over the window. Tape it tightly to the edges of the wall surrounding each window. This should give you from 3 to 6 inches of dead air space.

In older, loosely built houses the continuous exchange of cold outdoor air and warm indoor air in winter can be a

significant heat loss. Weatherstripping all exterior windows and doors and caulking around their frames will prevent

cold air from entering your house and also prevent the warm air in your house from escaping.

Is the crawl space open under your house or mobile home? Then it will pay you to enclose this area with rigid plastic or galvanized metal sheeting, thus shutting off the sweep of cold winter air.



But leave adequate openings for proper ventilation.

Summary

In these days of rapidly increasing prices of gas, oil, and electricity, anything you can do to cut down on the heat loss and heat gain of your house is well worth the time and money you spend doing it.

By doing all of the things we have outlined, you'll make your home more comfortable all year round and save a considerable amount of money on your heating and air-conditioning bills.

Use Electricity Wisely

prepared by
Tennessee Valley Authority
Division of Power Utilization

HOME IMPROVEMENT LOANS AND REPAIR LOANS AND GRANTS

FARMERS HOME
ADMINISTRATION
Program Aid No. 1184

A Rural Credit Agency of the
U.S. DEPARTMENT
OF AGRICULTURE

HOME IMPROVEMENT LOANS AND REPAIR LOANS AND GRANTS

A rural homeowner whose house needs fixing up may be eligible for a loan and/or grant from Farmers Home Administration (FmHA).

The agency makes home improvement loans to families who may not need or cannot afford a new house, but need some work done on their present house to bring it up to minimum property standards. It also makes loans as well as grants to homeowners to remove health or safety hazards from their dwellings. Grants are made only to low-income elderly homeowners, 62 years or older.

A borrower's income is the key to the type of assistance for which he is eligible.

If income is so low as to permit only removal of health and safety hazards, a *repair* loan and/or grant may be available.

For families with somewhat higher income, a *home improvement* loan may be possible to bring the house up to FmHA minimum property standards.

HOW CAN FUNDS BE USED?

The ways in which *repair loans and/or grants* and *home improvement loans* can be used are very similar, and FmHA county supervisors will help each borrower determine the type of assistance that best fits his needs and for which he is eligible.

Generally, *repair loans and grants* may be used to remove health hazards by repairing roofs, providing a sanitary water and waste disposal system that meets local health department requirements, installing screens, windows, or insulation, or taking other steps to make the home safe.

Home improvement loans may include similar purposes, but may go further by bringing the home up to minimum property standards, and making changes for the convience of the family, such as adding a room, remodeling the kitchen, or otherwise modernizing the house.

WHAT ARE THE TERMS?

FmHA county supervisors will help families determine the type of assistance that is best suited to their needs and their income.

Very low-income families can receive up to $5,000 in a loan, a combination loan and grant, or a full grant to remove health hazards. Loans up to $1,500 must be repaid within 10 years, loans between $1,500 and $2,500 within 15 years, and loans over $2,500 within 20 years. The interest rate is 1 percent.

To receive a combination loan and grant, an applicant must be 62 years or older and able to pay for only a part of the repairs.

To receive a full grant, the homeowner must be 62 years or older, and unable to pay for any repairs on the house.

Families with somewhat higher incomes can borrow up to $7,000 to improve their homes, but must bring the houses up to minimum property standards. Loans are for up to 25 years. Interest rates are based on each family's adjusted income. The interest rate will be 1 percent if the adjusted family income is less than $3,000. If the income is more than $3,000 but less than $5,000, the interest rate will be 2 percent. If income is between $5,000 and $7,000, interest will be 3 percent.

Other home improvement loans are repayable in 33 years. These loans are made at the regular interest rate, or with "interest credits," depending upon family size and income.

HOW IS ADJUSTED INCOME FIGURED?

The. county supervisor will help figure it out. Adjusted income is arrived at by adding up the total income of all adult members of the family who live at home. Substract a standard deduction of 5 percent, plus $300 for each minor child. The result is about what the family's adjusted income will be. There are other factors that do not affect all families, so be sure the county supervisor helps with the final arithmetic.

WHO CAN BORROW?

If you own and live in a home on a farm, in the open country, or in towns of up to 10,000 population, you may qualify for a loan and/or grant if you cannot secure credit from regular commercial lenders. The homeowner must be 62 years or older to qualify for a grant or a combination loan and grant. This assistance is also available in some towns of 10,000 to 20,000 population. Your town may be in this category. To be sure, ask the FmHA county supervisor whether this assistance is available in your town.

WHAT SECURITY IS REQUIRED?

A real estate mortgage is required for loans of more than $2,500, and in some instances may be required for smaller loans. If the loan is under $2,500, but income is small so that repaying the loan will be difficult, someone may co-sign the loan note with the borrower.

Homeowners who receive a grant or a combination loan and grant must agree not to sell the house on which grant funds are used for up to 3 years.

WHERE DO YOU APPLY?

Go to the local county office of the Farmers Home Administration. The office address can be found in the telephone directory under "U.S. Government—Agriculture." Or write directly to the Farmers Home Administration, U.S. Department of Agriculture, Washington, D.C. 20250.

ARE THERE OTHER CONDITIONS?

Applications from eligible veterans are given preference. Veterans and nonveterans must meet the same requirements.

Each person who applies will receive equal consideration regardless of race, color, creed, sex, marital status, or national origin.

WHAT OTHER CREDIT IS AVAILABLE?

Farmers Home Administration can make loans to build homes, buy existing ones, or to build rental apartments for low-income or elderly people. FmHA also can loan money to buy or operate family farms, build water and waste disposal systems, or establish community facilities such as fire stations, clinics, or community centers. It can guarantee housing loans for moderate-income families as well as loans to help establish job-producing businesses or industries.

This publication supersedes
"Home Improvement and Repair Loans,"
Program Aid No. 1128, issued October 1975

May 1977

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HOME WEATHERIZATION

a way to save energy and money

ARKANSAS' ELECTRIC COOPERATIVES

GREAT SAVINGS POSSIBLE

The amount of energy required for heating and cooling an existing home can be cut as much as 40 per cent if it's properly weatherized.

Forty per cent. More than one-third!

That could mean a big savings in energy.

It could mean a big savings in energy costs, too.

Energy savings of much more than 40 per cent are possible in an "Energy Saving Home" -- one designed and built according to certain rigid standards developed as a result of the nation's present energy dilemma.

Compared to a conventionally constructed house, an "Energy Saving Home" has the potential of a 65 per cent to 80 per cent energy savings for heating and cooling purposes!

But not everyone wants to build an "Energy Saving Home" right now. This brochure was prepared for people interested in the energy savings features that can be added to existing homes.

And not only will proper weatherization result in a significant energy savings, it'll also insure more home comfort.

The actual energy savings possible in heating and cooling a home that's properly weatherized will vary from one home to another. It'll depend in great part on how energy efficient the home was before the weatherization project was begun. It'll also depend on individual life styles.

No one can say how long it'll take to recover the cost of weatherization projects through the lower energy bills resulting from lowered energy use. That's because individual life styles differ, and because nobody knows how rapidly fuel shortages will force energy costs to go up more than they now are.

It's a fact, however, that energy costs will increase. But that increased cost will be less for a home that's properly weatherized than for one that's not.

WHAT'S INVOLVED

Proper home weatherization involves more than just adequate insulation, although that's a major part of it.

There are also such things as:

Storm windows and storm doors . . .

Ventilation . . .

Weatherstripping . . .

Vapor barriers . . .

Humidity . . .

Each has a definite role in proper weatherization. All are important.

INSULATION IMPORTANT

Insulation keeps warm air inside the home in winter months, and holds hot air outside during the summer. Adequate insulation is a "must" in any home weatherization program!

There are several types of insulating material suitable for use in insulating existing homes.

Mineral wool . . .

Cellulose fiber . . .

Vermiculite and perlite . . .

Plastic foams . . .

Mineral wool, which can be composed of either fiber glass or rock wool, is the type of insulation most frequently used in the past. Cellulose fiber will be an important part of the weatherization program because mineral wool is not available in sufficient quantities.

There are several forms of mineral wool insulation:

Blankets, which are long rolls of insulation that may or may not contain vapor barriers . . .

Batts, which are the same as blankets but are cut into lengths of either four feet or eight feet . . .

Poured material, which is "loose" material put onto attic floors . . .

Blown material, which is "loose" material designed to be blown into attics and walls with pneumatic equipment.

Cellulose insulation is another type of insulation in common use. It is made of paper, usually old newspapers, that has been ground up and treated to make it fire resistant and to give other desirable characteristics.

Cellulose insulation is a "loose" material that is installed with pneumatic equipment or scattered by hand.

Insulation is important not only in attics, under floors and in walls, but is also necessary around water heaters that are not enclosed in the weatherized portion of the home. It's also needed around the duct system through which heated or cooled air is delivered to vents.

DETERMINE "R-VALUE"

Regardless of what type or form of insulation is used, its efficiency is determined by its "**R-**Value." The "R-Value" is a unit of measurement relating to the material's resistance to heat flowing through it. The higher the 'R-Value" of the insulation, the greater its insulating capacity.

Before any type of insulation is decided on, the homeowner should determine that the material meets or exceeds certain Federal Specifications that have been established.

The appropriate Federal Specifications (and they should be clearly marked on the blankets, batts or containers of "loose" materials) are:

Mineral wool for "loose" application, either poured or blown – **HH-I-1030A.**

Mineral wool blankets or batts – **HH-I-52C.**

Cellulose for "loose" application, either poured or blown – **HH-I-515C** (should also meet the "flame permanency" specifications of American Society of Testing and Materials, and National Cellulose Insulation Manufacturers Association).

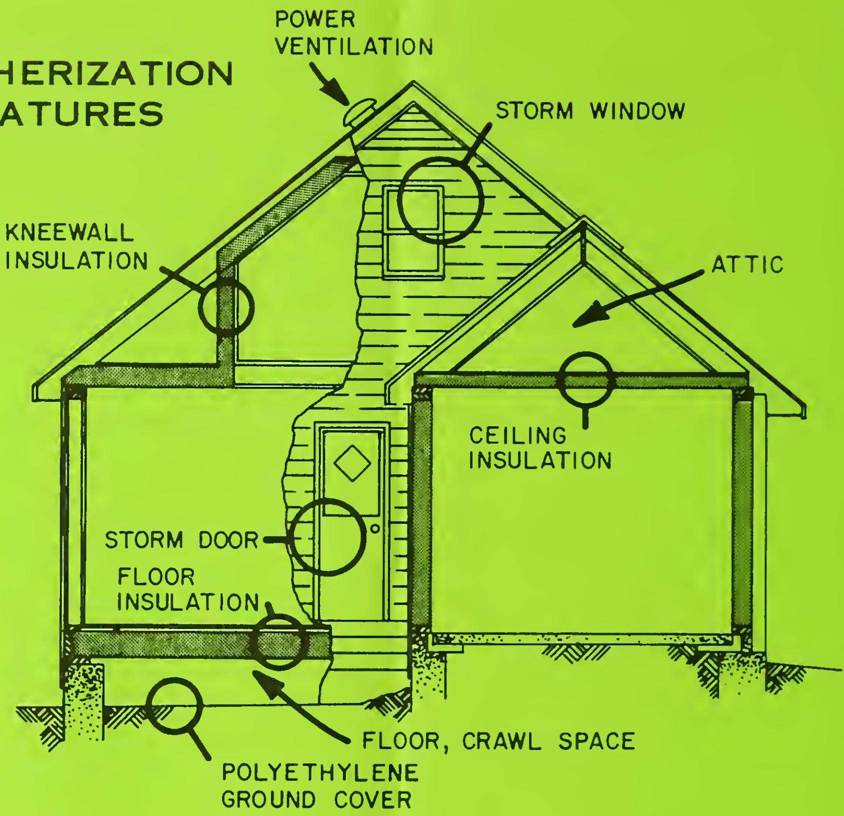
STANDARDS ADOPTED

Your electric cooperative has adopted a set of optimum "standards" for proper weatherization of existing homes within its service area.

Those standards are:

1. **Insulation.** Insulation should have the following "R-Values":
   Attics – R-38.

WEATHERIZATION FEATURES



INSULATING MATERIALS – MAXIMUM ACCEPTABLE R-VALUES

	R-Value per Inch	Inches Needed for R-19
Fiberglas Batts	R-3.2	6"
Blown Fiberglas	R-2.2	9" *
Cellulose	R-3.8	5" *
Rock Wool	R-3.3	6" *
Urea-Formaldehyde	R-4.2	
Urethane Board	R-8 with backing (R-7 1 without backing)	
Extruded Polystyrene	R-5	
Expanded Polystyrene	R-4	

*Note: R-values of these materials are based on using the manufacturer's required number of bags per thousand square feet.

Under floors – R-19. (For floors over crawl space.)

Around duct systems – R-7. (Rigid, round, fiberglass ducts will be accepted as meeting this standard.)

Around water heaters not located inside a weatherized portion of the home – wrapped with insulation with an insulation value of R-7 or greater, or use of an appropriate insulation "kit."

2. **Polyethylene ground cover** of 6-mil thickness under all houses where insulation has been installed under floors.
3. **Power attic ventilators**, sized to change the air in the attic every six minutes.
4. **Storm windows and storm doors** on all outside openings.
5. **Caulking and/or weatherstripping**, tightly installed, around all windows and doors.
6. **Humidity control** – dehumidifier for summer and humidifier for winter. A 40 to 45% relative humidity is recommended.
7. **Heat tempered glass cover for a wood-burning fireplace**, to provide for sealing, and including a damper on the cover.

NOTE: Insulation within walls of existing homes is not included in present weatherization standards. It's difficult to provide an adequate moisture barrier within existing walls. Materials and methods currently available for a good job are quite expensive, too.

HOME CHECK-UP IS ADVISABLE

Most people don't know too much about their homes' energy efficiency, so far as heating and cooling are concerned. It's advisable to have a "check-up" by qualified personnel to determine what needs to be done to make sure a home meets the weatherization standards. Ask your electric cooperative for a free energy audit.

A "check-up" is recommended before any weatherization is undertaken.

Make sure, too, that the "check-up" and any needed weatherization work is performed by a qualified and reputable contractor or firm. That's extremely important if the work is to be done properly and if it's to do the job it's supposed to do.

FINANCING IS AVAILABLE

There are several sources of funds for financing home weatherization projects. Check with your electric cooperative for information.

OTHER CONSERVATION TIPS

Proper maintenance of heating and cooling units is necessary if the efficiency of the equipment is to be at its best.

Filters in heating and cooling units should be changed regularly A dirty filter decreases equipment efficiency.

Use drapes, blinds or shades over large glassed areas. Open the drapes on sunny winter days and keep them closed on hot summer days.

Maintain a sensible thermostat setting. For each degree you heat your home above 72 degrees, it can cost you as much as 5% more per degree. For each degree you cool your home below 72 degrees, it can cost you as much as 5% more per degree.

Dress appropriately. Wear a sweater or jacket during the winter months, and loose comfortable clothing in the summer.

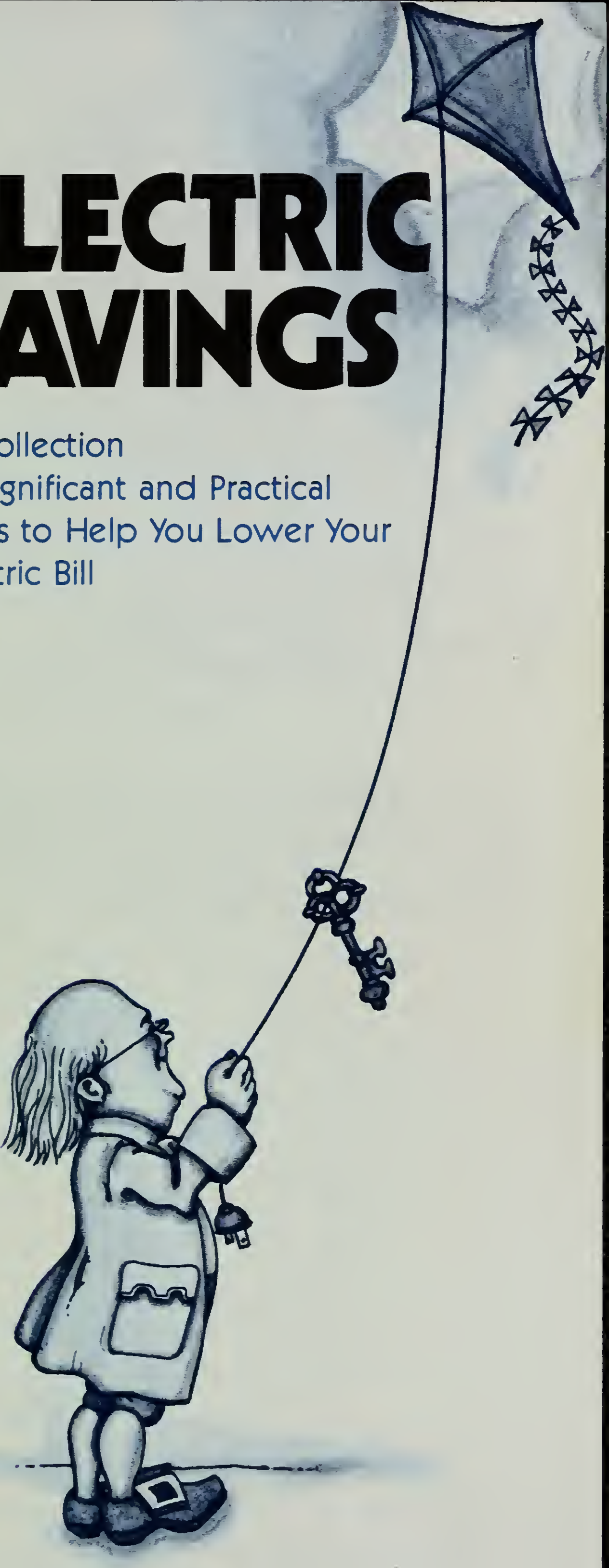
ENERGY CONSERVATION IS A CONTINUOUS THING

Any savings of energy that can be made -- no matter what the energy is, or in what way it's saved -- is important. Energy is too valuable to waste. It's also too expensive to waste!

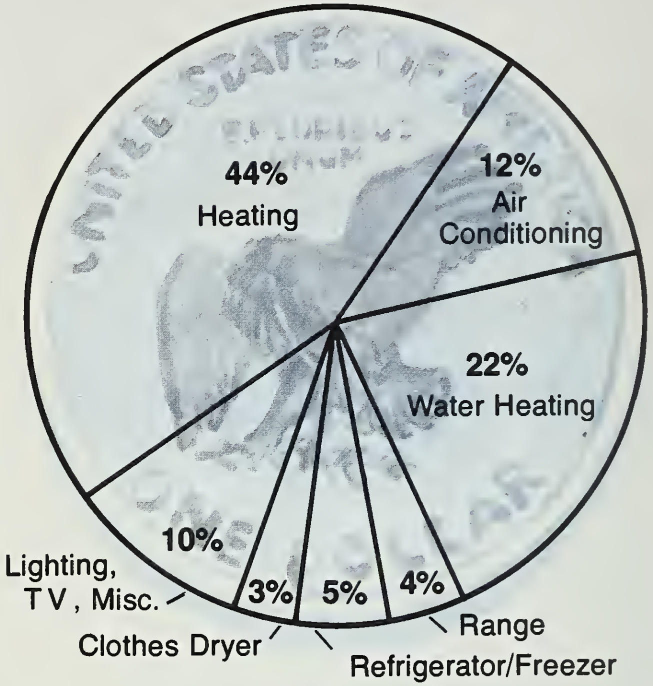
Energy conservation is everybody's business!

ELECTRIC SAVINGS

A Collection
of Significant and Practical
Ways to Help You Lower Your
Electric Bill



TENNESSEE VALLEY AUTHORITY



The chart and percentages used in this booklet are for an all-electric home in a 3500 degree day area. It has 1500 square feet, R-19 insulation in the attic, R-11 in the walls, and R-7 under the floor, plus storm windows and doors.

Foreword

Energy, once so cheap many people used it without thought and paid for it without bother, has become a leading item in the budgets of most of us. Moreover, energy experts forecast that the cost will continue to increase in the years ahead.

Is there no way to cope with this frustrating situation? We think there is. The way to hold a rein on this expense is to be very careful in its use. We should use energy wisely, efficiently, without waste. This doesn't necessarily mean we have to give up comfort and convenience.

To get started on your way to a wiser, more economical use of energy, read on. First, you will find sections on insulation, heating, water heating, and cooling — major areas where the most electricity can be conserved.

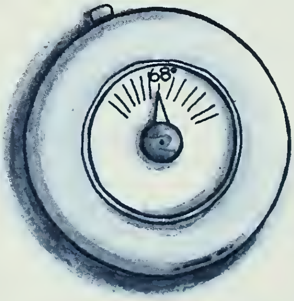
INSULATION

The best way to save the most electricity is to insulate your home. Compared to a home with no insulation, one with full insulation can reduce heating costs by half, cooling costs by one-third.

Put at least *R-19 in the attic and R-11 under the floor. If you can only insulate one area, make it the ceiling to cut off heat's main escape route. For new homes, we recommend Super Saver standards — R-30 in the attic and R-19 in the walls and under the floor.

For complete information about insulation and how you can install it yourself, ask your power distributor for a copy of **Installing Home Insulation.**

*("R" refers to the ability of a material to resist the flow of heat. The higher the R-number, the greater the insulating value.)



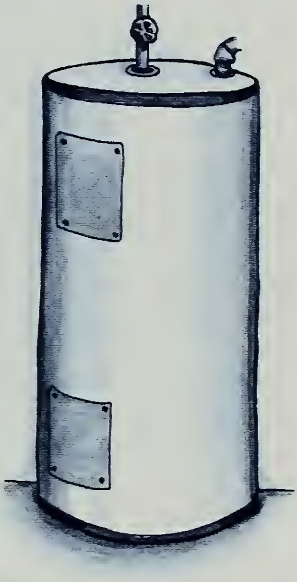
HEATING

Electric heat consumes more kilowatthours** than anything else in your home, averaging about **44** percent of the total electric bill each year. Heating is an area where big savings are possible.

1. Set the heating thermostats no higher than 68 degrees. (You may be asked to lower this temperature in times of energy shortage.)

2. Close doors to unused rooms and use low heat or no heat in them. (Don't close off rooms if you have a central system.)
3. Install storm doors and windows to reduce heat loss, or use plastic storm window kits.
4. Caulk around windows and weatherstrip doors.
5. Keep central system air filters clean.
6. Keep damper closed when not using the fireplace.
7. Keep outside doors **closed.**
8. When building a new home or replacing your existing heating system, check into the electric heat pump — the most efficient central electric heating you can buy.

**(Gasoline is sold by the gallon and electricity is sold by the kilowatthour. An easy way to "see" the measurement is to think of ten 100-watt light bulbs — when they have been on for one hour, they have used a kilowatthour.)

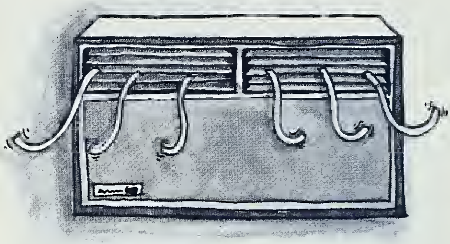


WATER HEATING

The electric water heater is on duty 24 hours a day, 365 days a year so you can wash your dishes, your clothes, and yourself. This is why it averages 22 percent of your annual electric bill. To lower the cost —

1. Wrap the electric water heater itself in 3½-inch-thick insulation.
2. Set thermostat(s) at 150 degrees or lower.

3. Wait until you have a full load before running the dishwasher.
4. Wash full loads of clothes in the coolest water possible.
5. Insulate hot water pipes that are in an unheated area.
6. Fix leaky faucets.
7. When building or remodeling, place the water heater nearest the point of greatest hot water use.



COOLING

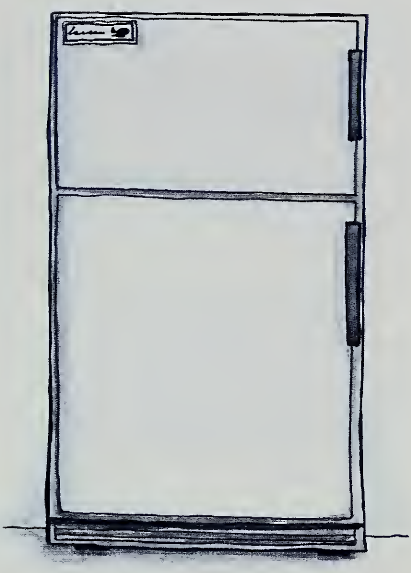
Averaging a little over **12** percent of your total annual bill, air conditioning is the third largest user of electricity in your home. To save money while staying cool, you should —

1. Set the cooling thermostat no lower than 78 degrees. (You may be asked to raise this temperature in times of energy shortage.)
2. Purchase a correctly sized air conditioner with a high energy efficiency ratio (EER).
3. Leave storm doors and windows in place year-round.
4. Close draperies on the sunny side of house.
5. Keep air conditioner filters clean.
6. Vent clothes dryer to outside.
7. Do heat-producing jobs, such as cooking and washing, during the cooler parts of the day.

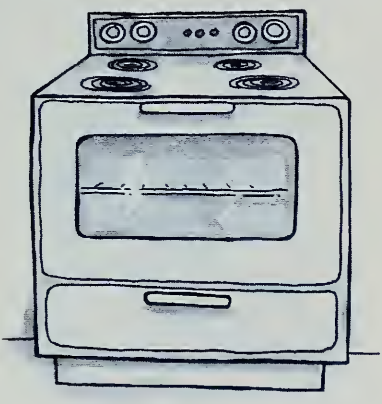
The following appliances are minor consumers of electricity. Therefore, while you can conserve some energy by using them wisely, you cannot begin to equal the savings possible with the first four items in this booklet.

REFRIGERATOR/FREEZER

These appliances add about **5** percent to your total electric bill yearly. You can shave a little off that percentage by —



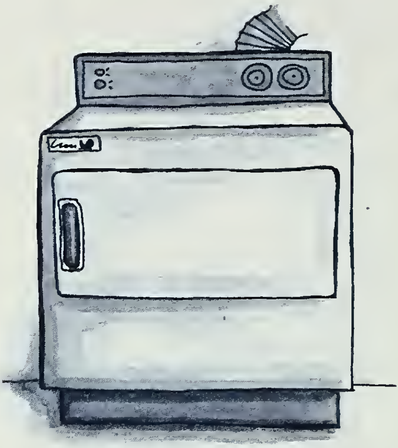
1. Setting the refrigerator temperature between 36-40 degrees, the freezer no colder than zero.
2. Defrosting, if necessary, before frost is ¼-inch thick.
3. Open the door as seldom as possible, then close it quickly.



RANGE

A little over 4 percent of your electrical usage each year goes for the electric range. You'll use less energy when you —

1. Use pans that fit the heating element you're using.
2. Avoid opening oven door until food is cooked.
3. Turn heat to "Low" after food begins to boil.
4. Cover pots and pans with tight-fitting lids.



DRYER

Three percent is all your automatic clothes dryer contributes to your total bill. You may help it contribute a little less by —

1. Drying full loads without overloading.
2. Cleaning the lint screen after each load.
3. Stopping it as soon as clothes are dry enough.

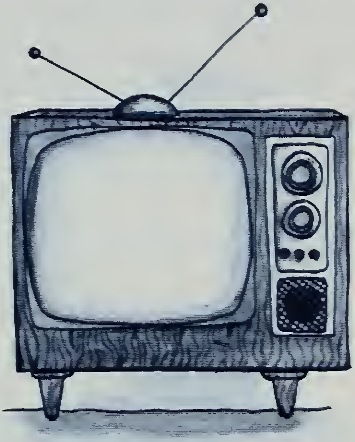
Lighting, television, the clothes washer, the dishwasher, and the various small appliances in the all-electric home all combined add only about **10** percent to your annual electric bill. Here are our suggestions on how to use them most efficiently.

LIGHTING

You'll be using lights wisely when you —

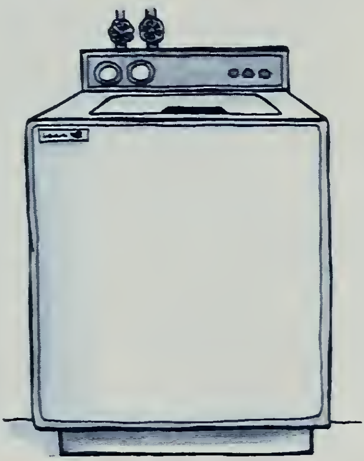
1. Use fluorescent lights.

2. Turn off any light not needed in the **summer.** But since lights produce heat, they will contribute to your heating system **in the winter.**
3. Use smaller wattage bulbs where lighting is not critical.



TELEVISION

All the free entertainment of TV adds a tiny percent to the typical electric bill. You might decrease that a fraction by doing one thing: Never let it play to an empty room.



CLOTHES WASHER & DISHWASHER

Out of your total electrical usage, the clothes washer and dishwasher consume little themselves. Most of the energy consumed when they are used is for the hot water. It is this hot water that adds considerably to your total bill.

With this fact in mind, you should —

1. Wash full loads of clothes in the coolest water possible.
2. Wash only full loads of dishes.

OTHER APPLIANCES

All the other appliances in the typical TVA region home add only a small percent to the average bill. Refer to your owner's manuals for their proper use. Pay attention to the varied jobs they can do. Then substitute them for major appliances whenever possible.

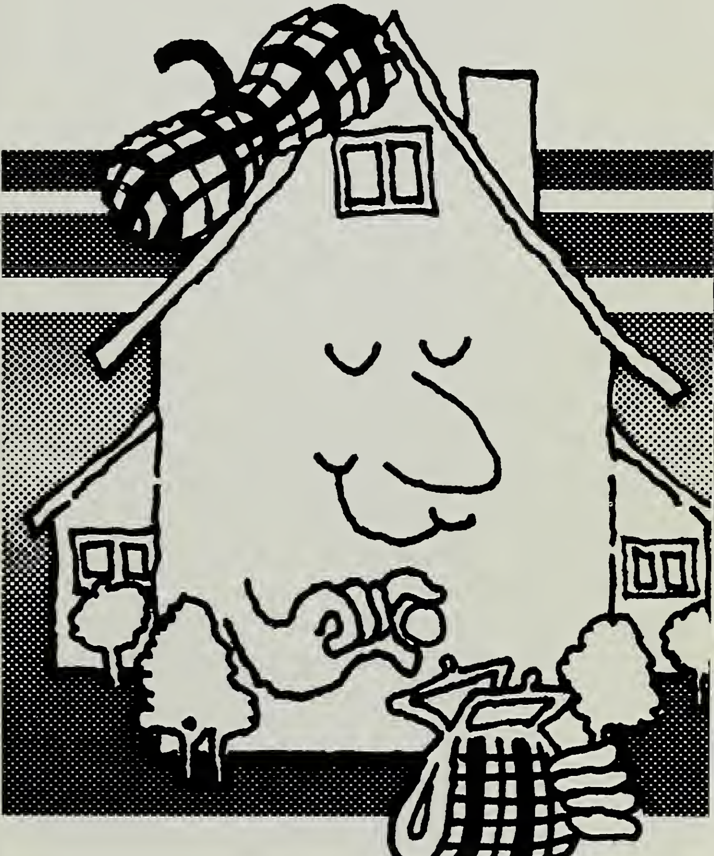
P.S. — ADEQUATE WIRING

For electrical efficiency and safety, adequate wiring is a must. If the wiring system isn't capable of carrying your home's full electrical load, appliances can't operate properly. Symptoms of inadequate wiring are — TV picture shrinks, lights dim, appliances heat slowly, and often fuses blow or breakers trip. If your home has any of these danger signals, you should have the wiring system brought up to national and local codes as soon as possible. Usually, this is a major undertaking, so deal with a reputable electrical contractor.


A Kilowatthour saved is a Kilowatthour you don't have to pay for. So use electricity wisely.

prepared by
Tennessee Valley Authority
Division of Power Utilization

BUILD AN ENERGY $AVING HOME



SAVE MONEY
SAVE ENERGY
ENJOY THE COMFORT

PURPOSE

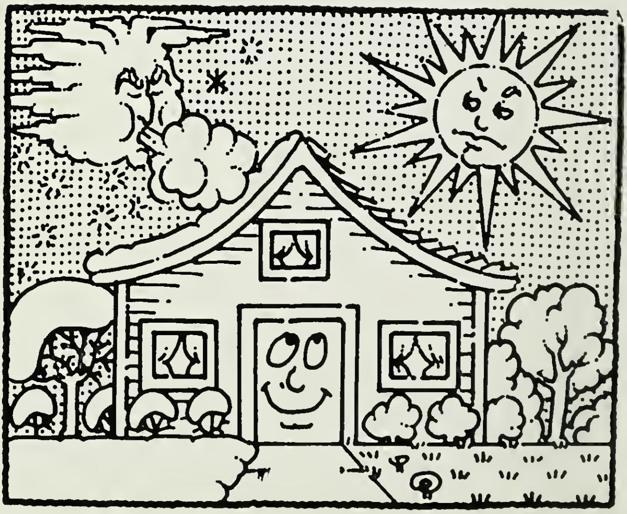
This folder is made available by your electric cooperative to provide you with basic information on the energy saving home, a home that will be comfortable and at the same time reduce the use of energy for heating and cooling as much as 65%.

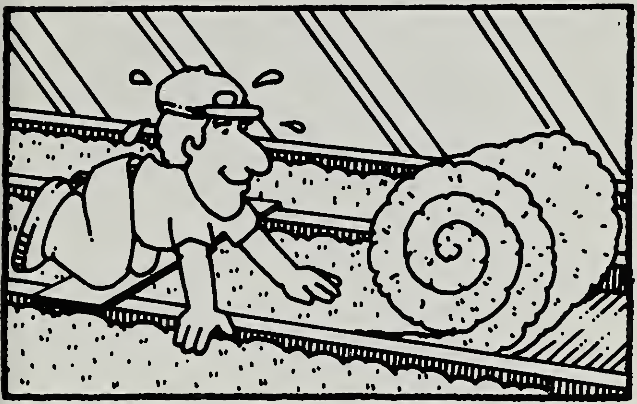
As the energy crisis confronting the country became more acute, it was apparent to electric companies and government agencies concerned with housing that there was a great need for homes to be more efficient in the use of energy, especially for heating and cooling.

Through a cooperative effort between the Arkansas Power and Light Company and the Little Rock area office of the Department of Housing and Urban Development, an energy saving home design has been developed. Applications containing this design are being approved in Arkansas by the Federal Housing Administration of HUD, the Farmers Home Administration and the Veterans Administration for insured loans.

Some of the information presented in this folder is of a technical nature. This was necessary in order to provide you with information that will be helpful when you talk with your builder about the home.

For more information, contact your local electric cooperative.





INSULATION

Quality insulation, properly applied, is the key to reducing winter heat loss and summer heat gain in the energy saving home. Insulation efficiency is indicated by the R-value. (The higher the R-value, the more efficient the insulation.) Insulation batts without attached vapor barrier are recommended, with continuous vapor barrier to be installed separately.

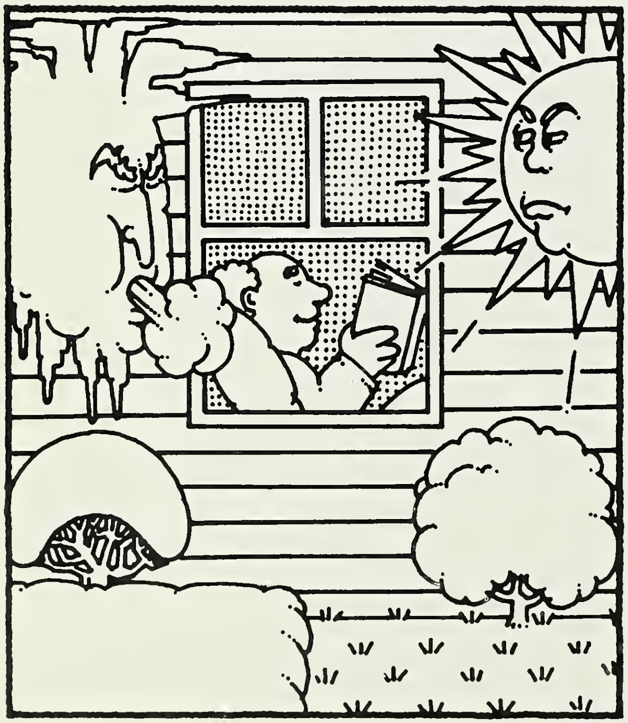
INSULATION RECOMMENDATIONS:

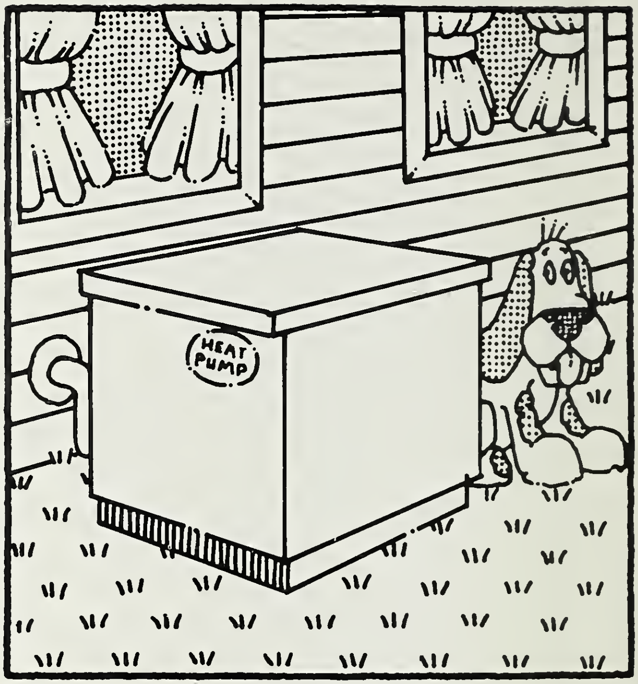
1. Exterior Walls: R-19 insulation carefully fitted between 2-inch x 6-inch studs, 24 inches on center (6-inch batts or equivalent).
2. Ceiling: Two batts of R-19 insulation for a total resistance of R-38. (Two six-inch batts or equivalent.) Batts should be fitted snugly to eliminate air spaces and should be extended full thickness to the outside edge of the walls. This requires a modified truss construction to provide a twelve-inch space between ceiling and rafters at the outside wall.
3. Floors: R-19 batt insulation is recommended for floors over a crawl space or basement. Batts should be suspended between the floor joists with wire clips. For slab floors, 1½-inch urethane board (R-10.7) should be installed vertically along the slab edge and should extend beneath the outer 20 inches of the slab perimeter. Floor insulation is an important factor that must not be neglected. Since warm floors contribute to overall comfort and permit comfortable living at a lower indoor winter temperature.

WINDOWS AND DOORS

Windows: Windows and doors are usually the greatest source of heat loss and gain. Window area should not exceed 8% of the floor area and should consist of a prime window with its frame caulked in place. Storm windows or insulating glass are recommended. Storm windows are preferred since they further reduce air infiltration. Glass areas should be protected by roof overhang, window coating or other acceptable shading method that will reduce the effect of solar radiation by at least 70% during the cooling season.

Exterior Doors: 1¾-inch steel clad doors with foamed urethane core and magnetic weather stripping are recommended (R-13.5). This reduces heat loss and gain through doors up to 90% over conventional designs. Weather stripped thresholds, caulked in place with base flashing are recommended.



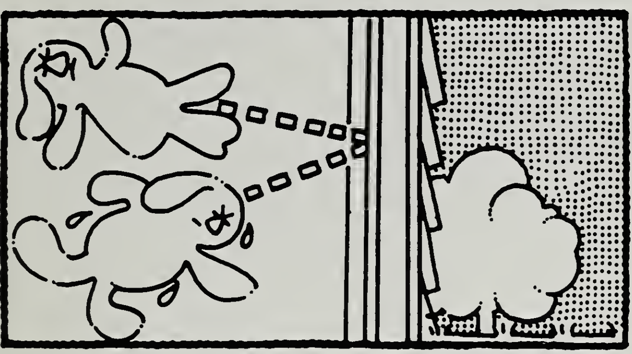


EQUIPMENT

Heating and Cooling: A central heating and cooling system is recommended with ducts located below the ceiling insulation and above a 7-foot high, furred down ceiling in the hallway to eliminate duct loss. For further energy savings, a modern heat pump system is recommended for most applications. A heat pump requires about half as much electrical energy as other electric heating systems because it utilizes existing heat in the outside air, giving maximum energy benefit for your energy dollar.

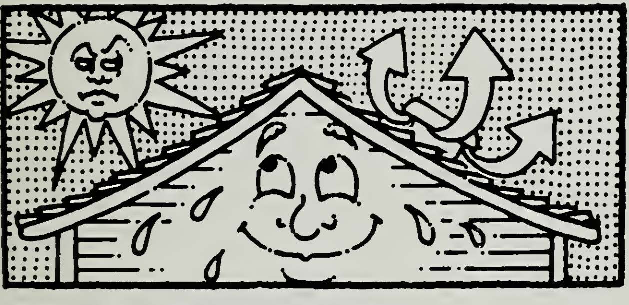
Humidity Control: A mechanical dehumidifier is recommended for adequate moisture removal. Small and medium sized homes with properly installed vapor barriers usually have no need for a humidifier to add moisture to the air, but one might be desirable in larger homes.

Air Cleaning: An electrostatic air filter is recommended, especially for smaller homes, because of the greatly reduced intake of outside air.



VAPOR BARRIERS

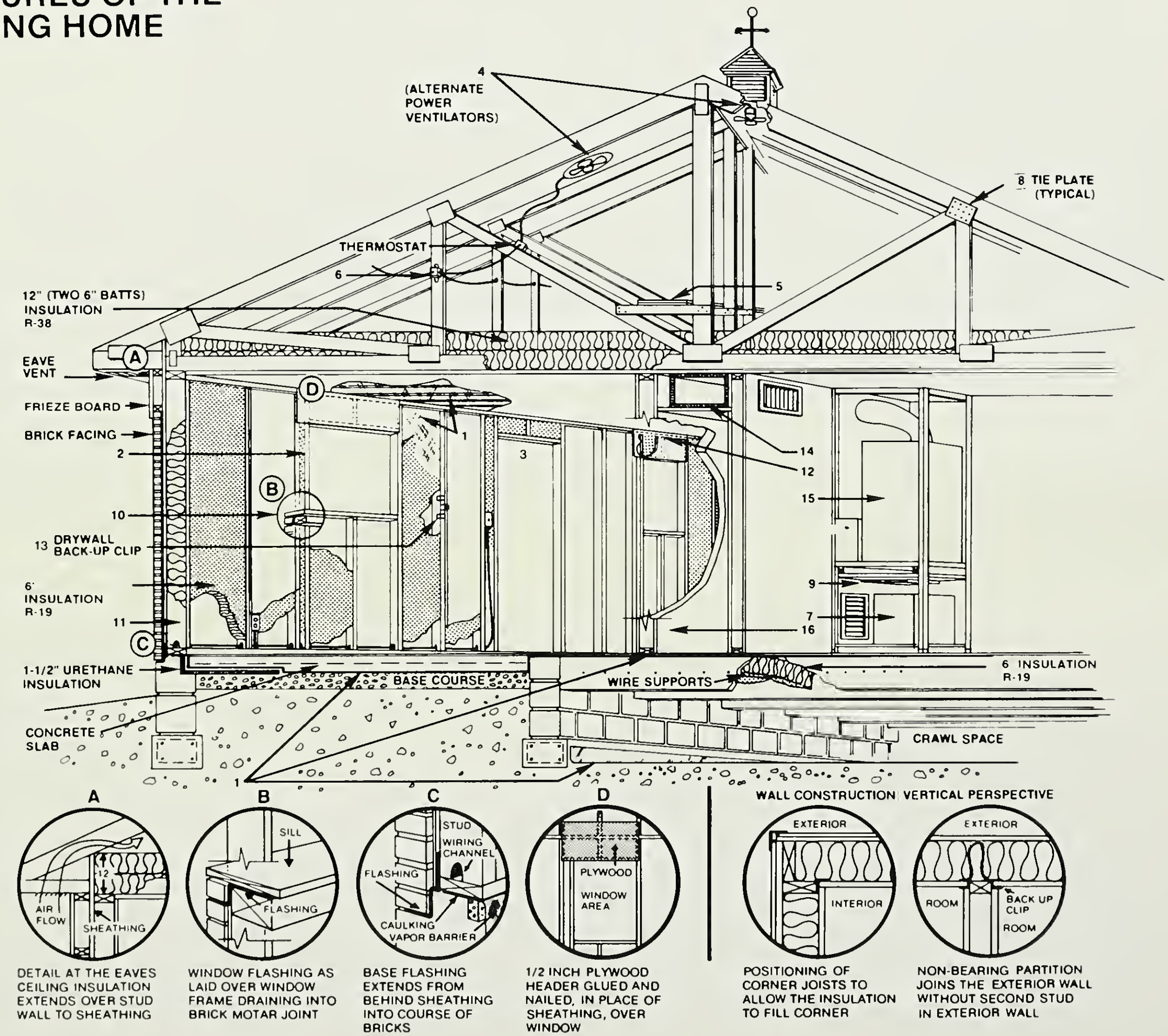
A continuous vapor barrier should be provided on heated side of all insulation to prevent moisture from entering and condensing in the insulation, with resulting mildew and deterioration. Either polyethylene of six-mill thickness or a foil-backing behind the gypsum board are recommended for this purpose. The kraft paper backing usually found on batt insulation is not considered adequate because it does not form a continuous barrier. A six-mill polyethylene vapor barrier must be installed beneath all concrete slab floors. For crawl space construction two polyethylene barriers are required —one above the subfloor and one on the earth surface beneath the house as a ground cover.



ATTIC VENTILATION

Power roof ventilators are recommended for all installations—with soffit vents spaced evenly along the eaves to provide 80 square inches of free area for each 100 CFM of fan capacity. Power ventilators should be sized to change the air in the attic space 10 times per hour and should be controlled by a thermostat set to turn on at 100°F. and off at 85°F.

DESIGN FEATURES OF THE ENERGY SAVING HOME



1. Vapor barriers
2. Windows
3. Exterior doors
4. Attic ventilators
5. Inspection catwalk
6. All wiring and piping must be installed so as to permit correct placement of insulation.
7. Dehumidifier
8. Tie Plate
9. Electrostatic Filter
10. Sill and window flashing
11. Wall studs
12. Window headers
13. Drywall back-up clips
14. Ducts
15. Air-handling equipment
16. Partition walls

SUMMARY OF RECOMMENDATIONS

Insulation: Attic R-38, walls R-19, floors R-19, slab floors R-10.8 around perimeter. Use 1½-inch urethane board around edge and beneath the outer 20 inches of slab perimeter. Use batt insulation without kraft or aluminum backing. R values for blown insulation must be determined from the number of bags installed rather than by inches of thickness.

Vapor Barrier: Continuous vapor barrier on inside surface of ceiling, floor and exterior walls —6 mill polyethylene or foil-backed gypsum board recommended for vapor barrier. All openings and tears must be sealed.

Attic Ventilation: Power roof ventilator that will change the air in the attic ten times per hour. Eave vents (no gable vents) with 80 square inches of area for each 100 CFM of fan capacity. Ventilator shall be thermostatically controlled to turn on at 100°F. and off at 85°F.

Windows: Window area not to exceed 8% of floor area. Prime window to be weather-stripped with its frame caulked in place. Use insulating glass or, preferably, storm windows with no direct contact of aluminum frames.

Doors: Urethane filled doors with magnetic weather-strip.

Equipment: Central heat pump or electric furnace properly sized to the heating and cooling load. Dehumidifier. Electrostatic air filter. No equipment to be located in attic.

Air Distribution: Locate all air distribution ducts in a furred down space below the ceiling insulation. Ducts should have ½ inch acoustical liner. All metal joints should be secured by three or more metal screws.

Framing: Six-inch wall studs on 24-inch centers for outside walls. Three-inch wall studs on 24-inch centers for interior non load bearing walls. Single top plate spliced directly over wall studs and reinforced with metal plates. Truss construction for roof using a modified truss that permits 12 inches of attic insulation to extend to the outside wall sheathing. Trusses must rest directly over wall studs and be joined to wall framing with metal ties. Extend exterior sheathing 12 inches above the top plate as a retainer for attic insulation. Use metal backup clips for gypsum board to eliminate T's at partitions. Use sill sealer or caulking beneath all sole plates and thresholds. Eliminate window and door headers from all non load bearing walls.

WHAT ABOUT COST?

The original goal was to design an energy saving home that would reduce energy use significantly for a reasonable increase in construction cost. Builders have found that the savings in material, labor and equipment keeps the initial cost about the same as for conventional construction methods meeting FHA minimum property standards.

FOR MORE
INFORMATION
PLEASE CONTACT
YOUR LOCAL
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DEVELOPING ARKANSAS RESOURCES

The Fireplace

Its selection and use

Tennessee Valley Authority

Foreword

In today's home, the fireplace has two main functions: It is to supplement the primary heating system, lessening the cost of electric or fossil fuel heating. And it is to look warm and inviting. When expertly constructed and wisely used, it can do both well, producing a surprising amount of heat from wood, our one renewable resource.

But if the fireplace is poorly built, it can be a smokey nuisance. And if it is improperly used, it will pull out more heat than it produces.

This booklet is designed to help you select the right type of woodburning fireplace for your home, one that will work for, not against you.

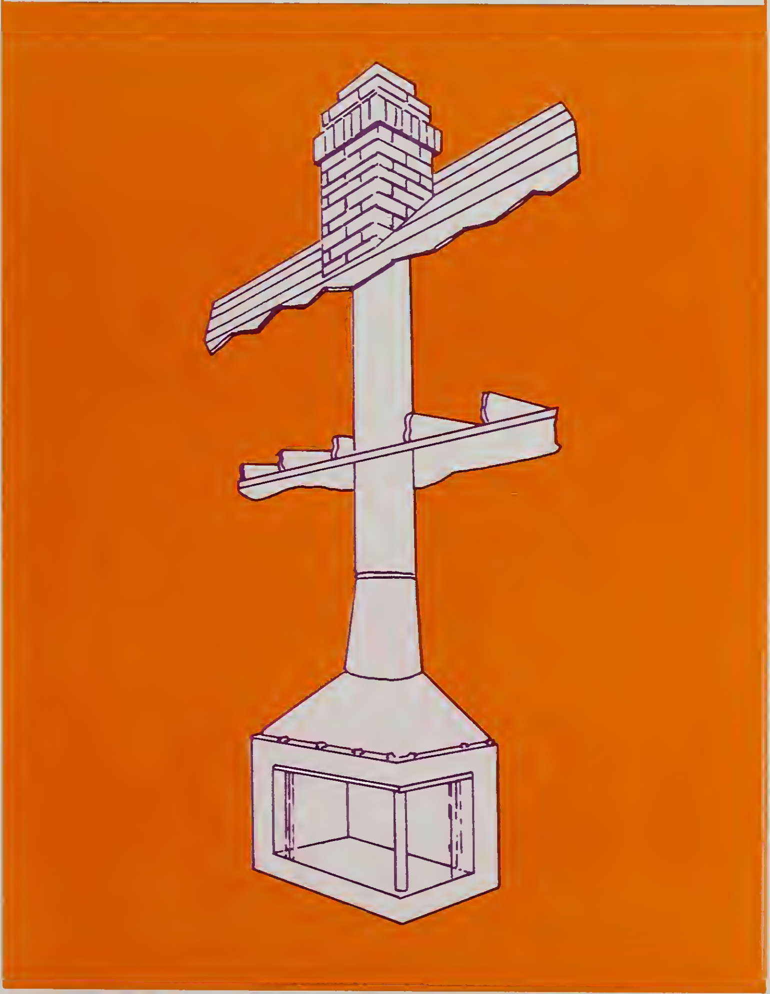
Types of Fireplaces

Free Standing Fireplace or Stove

Under $500.
Light weight (can be installed on existing floors).
High efficiency (30-85%).
Pre-engineered to function properly.
Can be installed by most do-it-yourselfers.
May have shorter life than masonry fireplace (thin metal units may burn out.)
Must be placed a certain distance from walls and other combustible material.

Pre-Built Installed Fireplace

Between $500-$1500.
Medium weight (can usually be installed on existing floors).
Slightly higher efficiency than solid masonry type; still higher efficiency possible with heat circulating model.
Pre-engineered to function properly.
Can be installed by most do-it-yourselfers.
Glass door fire screen should be used.
Outside air supply is recommended.
Adds to home value.



Masonry Fireplace

Between $1000-$3000.
Very heavy (needs separate foundation).
Low efficiency — 10% or less — (higher efficiency available with masonry or metal heat circulating types).
Should be built by qualified mason (one mistake can be costly).
Should have outside draft and combustion air supply.
Glass door fire screens should be used.
Has traditional appeal and charm.
Adds more to home value than other types.

Mobile Home Fireplace

Between $350-$500.

Similar to pre-built installed fireplace but with these differences:

- Air for the fireplace must be brought in from outside.
- No dampers are permitted on the combustion air inlet or flue gas outlet.
- There must be a door to close off the fireplace.
- The door, usually glass, should be kept closed except when adding fuel.
- Chimney must have a spark arrester.
- Wood, coal, or charcoal may be burned.
- Unit must carry seal of Underwriters Laboratories (UL). If it doesn't, it likely does not meet the above standards and shouldn't be used in your mobile home.

Your local library has books containing dimensional data and technical information on building and installing fireplaces.

General Tips

1. Before firing up your fireplace, turn down any other heat in the room; set the thermostat at 65 degrees or lower. (Heat from your primary heating system goes up the chimney, so let the fireplace provide most or all of the heat in a room.)
2. If proper draft is a problem, especially while starting the fire, slightly open the window nearest the fireplace. However, a built-in outside air supply eliminates this problem.

3. Leave about one inch of ashes in the hearth for insulation. The fire will start easier and burn better.
4. For the most heat, keep the fire active and as far forward as possible without causing a smoking problem.
5. Mild weather is when you can turn **off** your primary system and let the fireplace supply all your heat. It is at these times that a good fireplace can help cut primary heating costs.
6. For safety and efficiency, the chimney should be kept clean. From the roof, pull a heavy chain up and down inside the chimney. Or use a burlap sack filled with gravel tied to a long rope.
7. The top of the chimney should be covered with a removable one-half-inch mesh screen as a spark arrester and to keep out birds. (Never consider using ordinary screen wire; it quickly clogs with soot.)
8. A metal or masonry hood over the chimney top will reduce the problem of rain and will help deflect the wind, which can cause smoking problems.

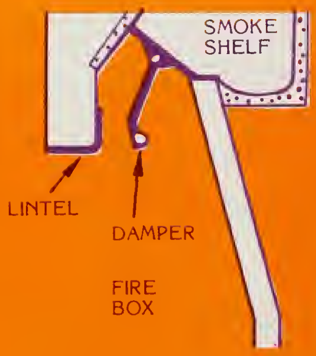


Figure 1

Operation of the Damper

A damper regulates the air flow or draft through the fireplace. The size of the damper opening should correspond to the size of the fire. Narrow for a little fire. Wide for a big one.

All fireplaces (see Figure 1) should have a full closing, regulating type damper. If your unit doesn't have a damper, one should be added as soon as possible. A built-in damper in a brick or stone fireplace will take some masonry work. Easier to install is a chimney top damper available for all type fireplaces. (See Figure 2.)

Until a damper can be installed, a flat metal plate should cover the front as tightly as possible when the fireplace isn't being

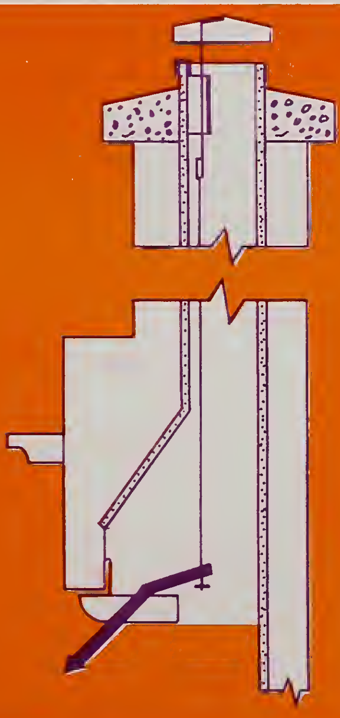


Figure 2

used. For easier handling of the plate, drawer handles and metal shelf brackets for feet may be added. (See Figure 3.)

When the fire is dying out, keep closing the damper down as far as possible without causing smoke. But as long as there are hot coals, don't close the damper completely. At this time, you should also use the flat metal plate to cover the opening to greatly reduce the loss of heated air. When the fire is out, the damper has to be closed tightly to prevent the draft from stealing heat from the room.

Every hour, an open damper can draw as much as 20 percent of the warm air from a room. It can also cause cold drafts near windows and doors. This causes the primary heating system to operate more often, causing your heat bill to be more expensive. So keep the damper closed until you use the fireplace again.

After some practice, you'll be able to fine tune the damper to pull a draft that will draw the most heat from the least wood.

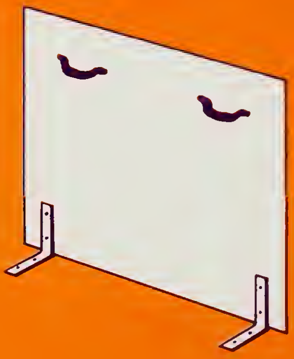


Figure 3

Figure 4

Accessories for Increased Efficiency

Glass Door Fire Screen

It reduces air flow up the chimney (see Figure 4) and allows the closing up of the fireplace. Obviously, the flat metal plate mentioned on page 7 isn't needed with this type screen.

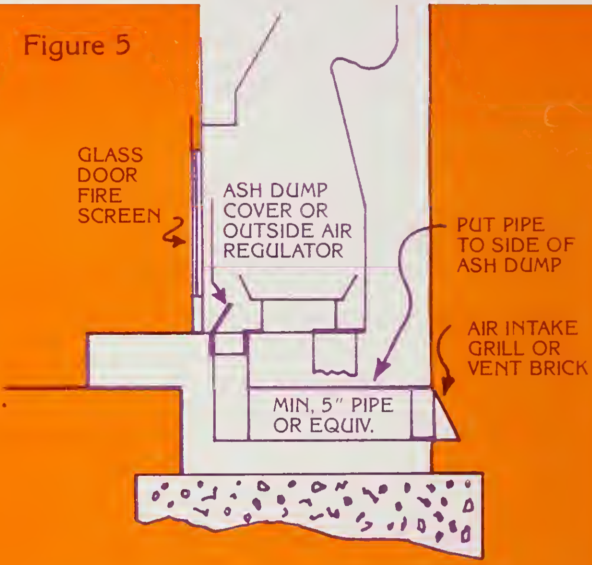
When using a glass screen, the fireplace should have an inlet for outside air. This is necessary for better burning and to prevent the loss of heated air from the room. (See Figure 5.)

While both wire mesh and glass screens offer looks and protection, the glass screens offer the bonus of saving energy.

Heat Savers

The widespread use of fireplaces to help save high energy costs and the low efficiency of fireplaces have generated the development of many types of heat savers. (See Figures 6 & 7.) These units approximately double the efficiency of a fireplace.

Figure 5



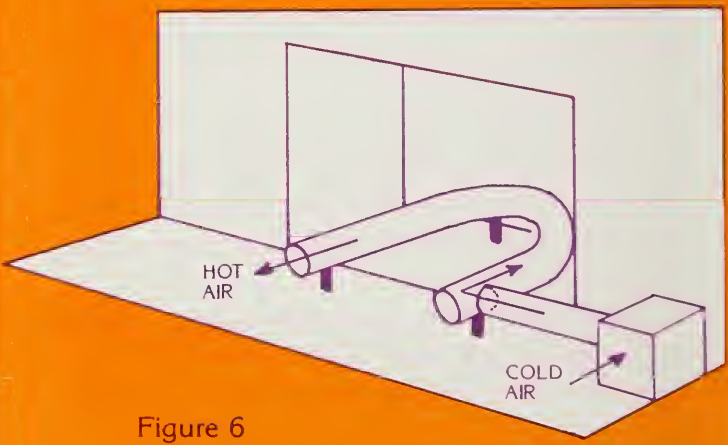
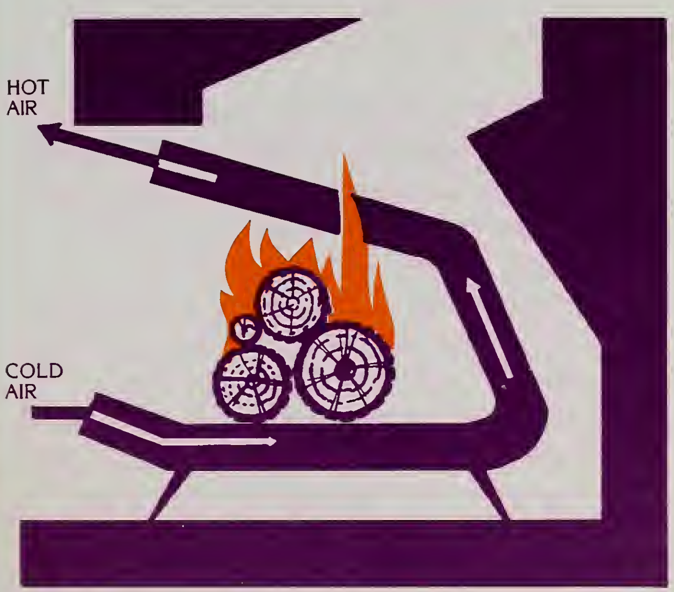


Figure 6

Figure 7



These designs incorporate increased reflection with polished metals. And with natural or forced convection through tubular flow designs. Most of these units do increase heat output considerably. Many, however, are high in price. A do-it-yourselfer may want to design and build his own from steel pipe or tubing. Small blower motors can be obtained from electric motor distributors.

Firewood

It's helpful to know your woods for the type fire you want. Dense hardwoods such as oaks and hickories burn relatively slow and produce more heat per cord than softwoods. Cedar, pine, and other softwoods ignite easier and are desirable when you want a fast warm-up fire simply to remove the chill. For an all-day fire, a combination of hardwoods and softwoods burns long and gives plenty of heat. A fire built between two hardwood logs lying across the front and back of the hearth will likely be the most satisfactory. Seasoned or dry wood of any type produces more heat than green or wet wood. It should be seasoned at least three months after cutting and kept dry before use.

Wood is normally sold in quantities of a **cord**. A cord is a stack 8 feet long, 4 feet wide, and 4 feet high (or 128 cubic feet). A standard pick-up truck load is approximately one-half cord.

For more information on wood types, their heat contents, and the typical amounts needed, consult the **Forestry Handbook** at your local library or write to TVA, Division of Forestry, Fisheries, and Wildlife Development Office, Norris, TN 37828, for a copy of the helpful booklet **What You Should Know About Firewood — Before You Buy.**

Fire Insurance

Insurance companies do not consider a fireplace a fire hazard. Instead, it enhances the value of your property, they say.

However, some insurance companies may decline to insure homes that use a woodburning stove or free-standing fireplace as the sole source of heat. They maintain that this does present a fire risk. Each home is considered an individual case. So before installing one, check with your insurance company.

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Tennessee Valley Authority
Division of Power Utilization

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RESIDENTIAL INSULATION STANDARDS Tab 8

Farmers Home Administration (FmHA) Residential Insulation Standards - July 1, 1978
Farmers Home Administration (FmHA) Construction Standards - March 15, 1978

HOUSEHOLD APPLIANCES AND EQUIPMENT USE Tab 9

Residential Uses - Electric Power Research Institute
Energy Efficiency and Appliance Use - Georgia Cooperative Extension Service
Household Appliances - Operation Costs - Arkansas Cooperative Extension Service

FACT SHEET

UNITED STATES
DEPARTMENT
OF AGRICULTURE

ENERGY
CONSERVATION
IN THE RURAL HOME

Landscaping To Cut Fuel Costs

Planting trees and shrubs around your home will help to reduce your heating and cooling costs. How much it reduces costs depends on your choice of plants and where you locate them.

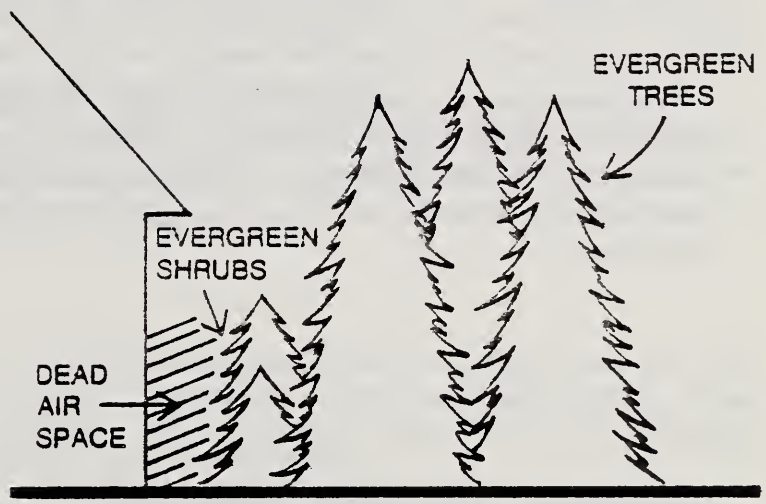
Trees and shrubs also reduce noise and air pollution, and make your home more attractive and more valuable. Therefore, money spent on landscaping your home is a good investment.

Wind Effects

An unprotected home loses much more heat on a cold windy day than on an equally cold still day. Well-located trees and shrubs can intercept the wind and cut your heat loss.

Up to one-third of the heat loss from a building may escape through the walls and roof by conduction. Wind increases the convective air currents along outside walls and the roof, thus increasing the heat loss.

Infiltration or air leakage can account for as much as one-third of heating losses in some buildings. Cold outside air flows in through cracks around windows and doors, and even through the pores in walls. This produces drafts that may cause you to over compensate by raising the thermostat to unreasonable levels just to maintain a modicum of comfort. Both windbreaks and foundation plantings can cut down this penetrating power of the wind.



Windbreaks of two to five rows of trees and shrubs generally provide good protection. Evergreen trees provide the best protection.

Windbreak Benefits

Studies of windbreaks show that windbreaks can reduce winter fuel consumption by 10 to 30 percent.

One study in Nebraska compared the fuel requirements of identical test houses which maintained a constant inside temperature of 70°F. The house protected by a windbreak used 23 percent less fuel.

In one month, an exposed electrically heated house in South Dakota used 443 kilowatthours to maintain an inside temperature of 70°F. An identical house sheltered by a windbreak used only 270 kilowatthours. The difference in average energy requirements for the whole winter was 34 percent.

The amount of money saved by a windbreak around a home will vary depending on the climate of the area, location of the home, and what the house is built of. A well-weatherized house with adequate ventilation, caulking, and weatherstripping won't benefit from windbreaks nearly as much as a poorly weatherized house.

In addition to reducing the force of the wind, windbreaks also can reduce the wind chill impact on people outside the house.

Studies of three-row windbreaks, where trees were 25 feet tall, show that wind velocities and the wind chill index were effectively reduced. See table.

Impact of a 3-Row Windbreak of 25′ Trees

Measured wind velocities in miles per hour	5	10	15	20	25	30
Wind chill index at 10°F	7	−9	−18	−24	−29	−33
Velocities in miles per hour, 75 feet in lee of a windbreak	0.5	2	3	5	8	15
Moderated wind chill index at 10°F, 75 feet in lee of a windbreak	9	8	8	7	−2	−18
Difference degrees Fahrenheit	2	17	26	31	27	15

Windbreaks can be located to control snow, too. This reduces the energy required to remove the snow from around homes, other buildings, and roads. Make sure windbreaks are located so as to have the desired effect on drifting snow.

Windbreak Design and Composition

The height and density of trees determine the amount of protection they will provide. Windbreaks of two to five rows of trees and shrubs generally provide good protection. Evergreen trees provide the best protection, although low, branching deciduous trees can significantly reduce windspeed. Even a single row of evergreen trees will give some protection. Windbreaks will reduce wind velocity significantly for a distance of about 10 times the height of the trees. Thus, a windbreak 30 feet high protects an area extending as far as 300 feet downwind. Some protection is provided for as far as 20 times the height of the trees. Maximum protection is provided within a distance five times the height of the trees.

For onsite assistance in locating and designing windbreaks, and selecting appropriate trees and shrubs, contact your local USDA Soil Conservation Service office, county extension agent, or farm forester.

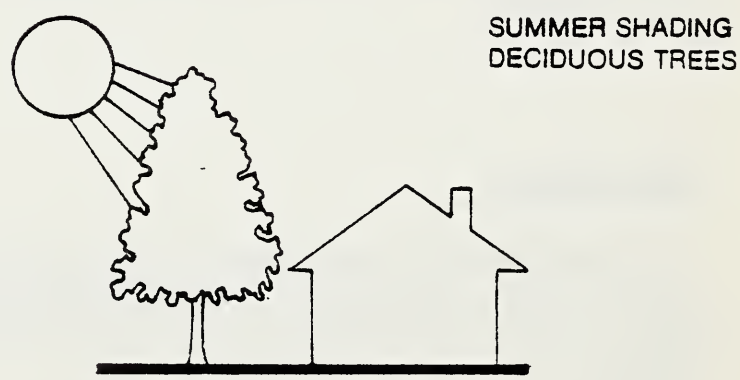
Foundation Planting

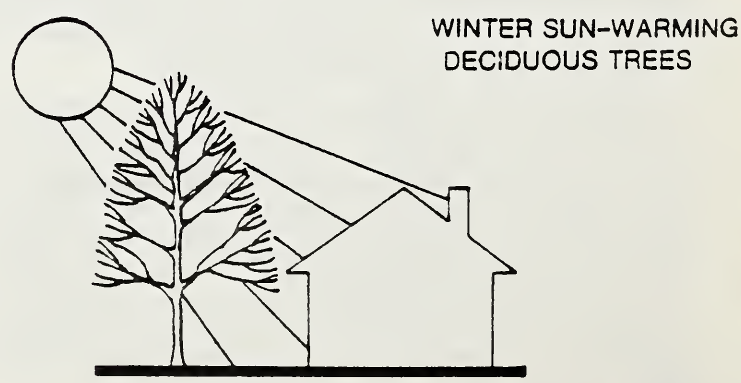
Trees and shrubs planted close to buildings reduce wind currents that otherwise would chill the outside surfaces. These foundation plantings even create a "dead air" space which slows the escape of heat from a building. These plantings also help reduce air infiltration losses around the foundation of the house. Again, evergreen trees and shrubs are thicker and are more effective than deciduous plants. To be most effective, the evergreens should be planted close together to form a tight barrier against air movement.

In summer, the same dead air space helps insulate your home from hot outside air, thus reducing the need for air conditioning.

Solar Radiation Control

Trees and shrubs control solar radiation by shading people and buildings from the direct rays of the sun. During winter, deciduous trees and shrubs shed their leaves and let the sun's rays help warm the house. This might be an important consideration if you are planting for summer shade on the southern exposure of your house.





During winter, deciduous trees and shrubs shed their leaves and let the sun's rays help to warm the house.

Planting for Shade

Maples and other trees with full crowns are best for summer shading. Their high branches permit greater visibility and do not block the flow of cooling summer breezes.

Evergreens have a cone-shaped crown which provides less summer shade on walls and roofs. Their branches often extend to the ground, blocking visibility and the flow of cooling breezes. If planted in the wrong location, they may shield your house from the sun's warmth in the winter.

Trees provide maximum shade when planted in groups beside your house. However, a roof need not be totally shaded to achieve excellent results. A study in Alabama showed that air-conditioning costs could be reduced effectively as long as a roof averaged 20 percent or more shade for the entire day.

Another study showed that an 8°F difference between shaded and unshaded wall surfaces was equivalent to a 30-percent increase in insulating value for the shaded wall. Temperature differences larger than 8°F between shaded and unshaded building surfaces are common.

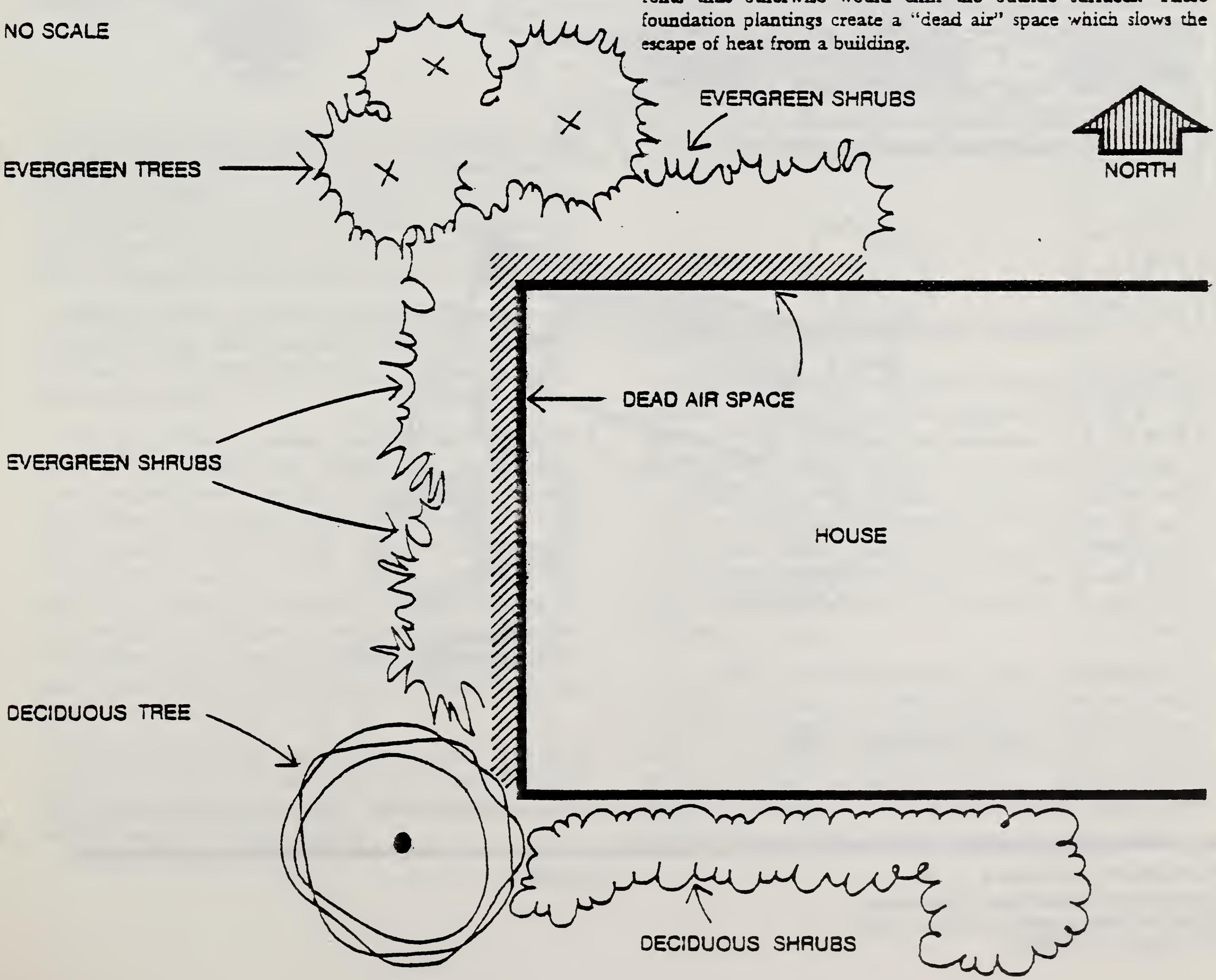
Deciduous vines that cling to trellises along the wall can afford protection on the south and west sides of your house. But remember that vines which cling directly to the walls may cause some structural deterioration. By providing direct shade on the walls, vines keep surface temperatures down and reduce convection-caused heat gain. Some additional cooling comes from the evaporation of moisture from the leaves. Evergreen vines such as English Ivy should not be used on walls facing south since the vines block the winter sun's warming rays. Vines may help to insulate walls on the northern and western sides by curbing winter winds.

For specific information on trees, shrubs, and vines for landscape planting in your area, contact your local extension agent.

TYPICAL FOUNDATION PLANTING

NO SCALE

Trees and shrubs planted close to buildings reduce wind currents that otherwise would chill the outside surfaces. These foundation plantings create a "dead air" space which slows the escape of heat from a building.



Fact Sheets In The Home Weatherization Series

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2. How To Determine Your Insulation Needs
3. Save Heating And Cooling Dollars With Weather-Stripping And Caulking
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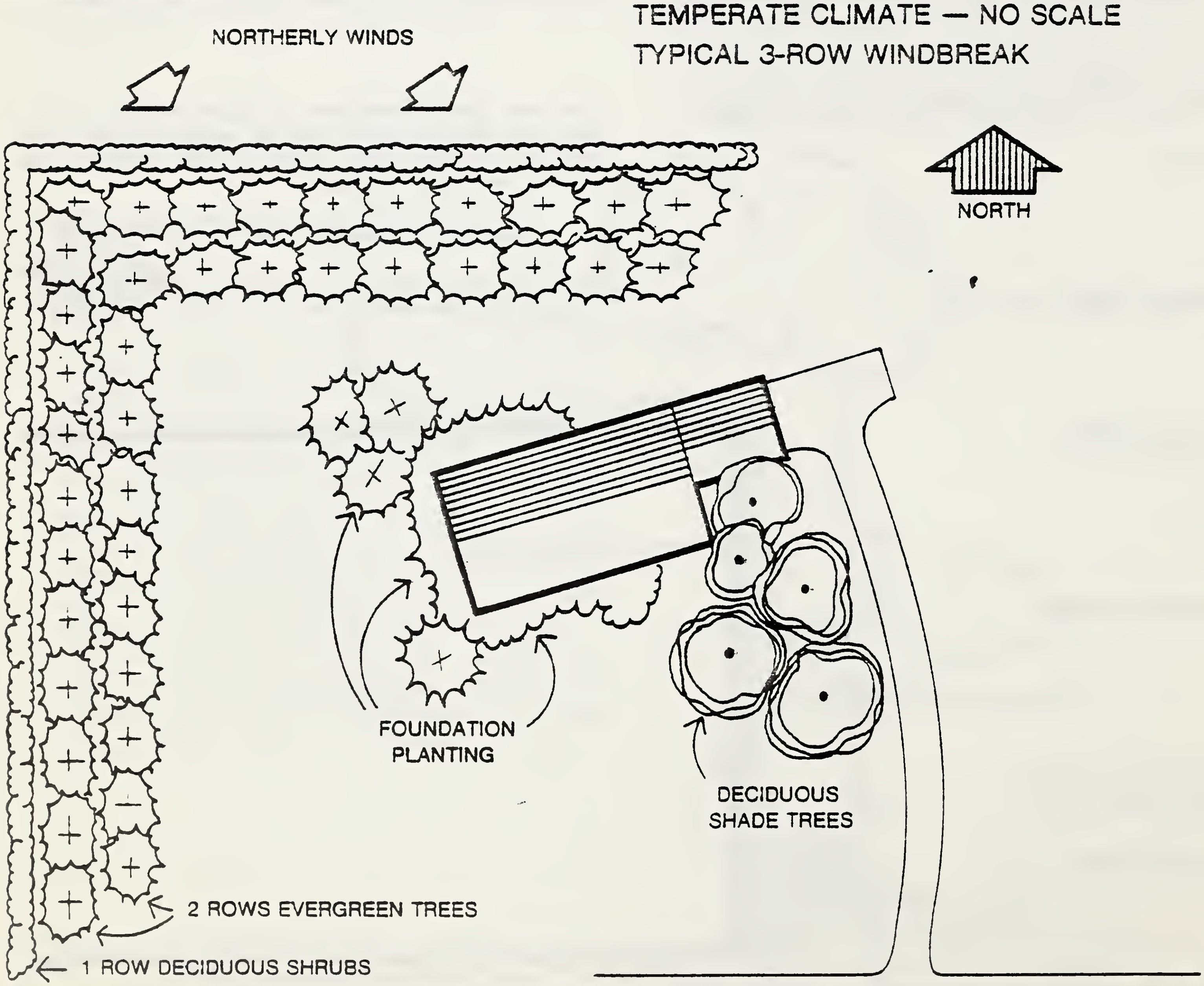
The amount of money saved by a windbreak around a home will vary depending on the climate of the area, location of the home, and what the house is built of.

TYPICAL PLANTING PLAN

TEMPERATE CLIMATE — NO SCALE
TYPICAL 3-ROW WINDBREAK



Agricultural Fact Sheet 2 - 3 - 5
United States Department of Agriculture
Office of Governmental and Public Affairs
Washington, D.C. 20250

July 1978

FACT SHEET

UNITED STATES
DEPARTMENT
OF AGRICULTURE

ENERGY
CONSERVATION
IN THE RURAL HOME

SOLVING MOISTURE PROBLEMS WITH VAPOR BARRIERS AND VENTILATION

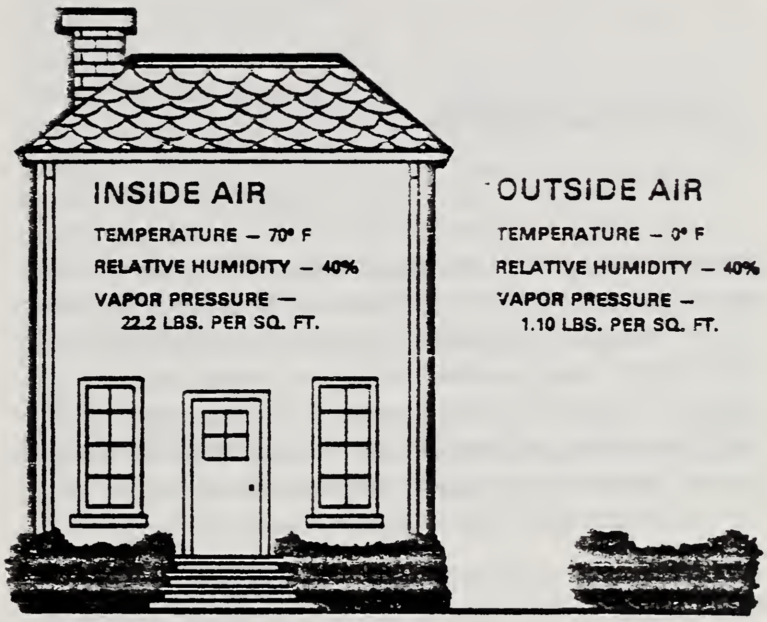


Figure 1. Vapor pressure difference between indoors and outdoors causes the movement of moisture into the walls.

When you install insulation—or "weatherize" your home in other ways—you may alter the movement of moisture through the walls, ceilings, and floors. Signs of undesirable moisture movement are: peeling paint, water stains in the attic, or an extremely damp crawl space. Trapped moisture invites decay and insects.

Moisture which gets into insulation also increases the rate of heat loss; therefore, you should control moisture as an essential part of your own energy conservation plan.

During the heating season, warm indoor air holds more moisture than cold outdoor air (fig. 1). This creates vapor pressure inside, which constantly forces water vapor out through walls and ceilings as it seeks lower moisture levels outside. When moisture levels within walls, attics, or crawl spaces become high, the water vapor tends to condense on cold surfaces. In most structures moisture can escape to the outside, but if moisture moves into the walls, ceiling, or crawl space faster then it can escape to outside air, the moisture will build up.

Here are three things you can do to control moisture buildup: (1) control humidity in the house; (2) install vapor barriers in walls, floors, and ceilings; and (3) ventilate attics and crawl spaces.

CONTROL HOUSEHOLD HUMIDITY

In cold climates, set your indoor controls for relative humidity in the winter no higher than 35 to 40 percent. When outdoor temperatures are 20° F or lower, reduce the humidity to less than 35 percent. Although a higher humidity might be healthier and might improve the performance of your heating system, it could cause serious condensation problems in your home. When condensation develops on insulated glass windows, you know that the relative humidity is definitely too high.

You add to the moisture level inside your home by bathing, cooking, and doing laundry. These activities can raise the humidity level too high. Exhaust fans in baths and kitchens will help eliminate this moisture before it spreads through the house. Clothes dryers should be vented to the outdoors. If high humidity persists, you might consider using a dehumidifier,

even in winter. This, however, would be necessary only in an exceptional situation.

If your home is too dry, use a humidifier. Set the controls no higher than the humidity that is recommended for your climatic zone. Watch the windows and cut back the humidifier if you see excessive condensation forming on them. Major humidifier manufacturers provide a schedule of settings that are appropriate for outdoor temperature levels.

VAPOR BARRIERS

A vapor barrier is any material that effectively slows the movement of moisture from a point of high vapor pressure to one of lower vapor pressure—such as from the inside of a warm home toward the outside cold air. Vapor barriers should always be placed near the warm side of the wall, ceiling, or floor. Materials near the cold side should permit moisture to escape out of the wall or ceiling to the outside. A vapor barrier that is placed on both the inside and outside of a wall will trap moisture and invite decay.

Small vents installed near the top and bottom of stud spaces will allow moisture to escape where no vapor barrier is used. In some instances, however, these vents may result in higher moisture in the insulation because cold air entering the cavity moves the dew point (the temperature at which condensation occurs) toward the warm or house side of the cavity. The vents do reduce moisture levels near the siding or outside wall. This may help prevent peeling of paint, even though there is a greater heat loss.

Blanket insulation with a vapor barrier backing is frequently used in new walls. Tabs of the backing should always be attached over the edge of studs with tabs lapped. Additional strips should be used over uninsulated areas such as window framing. Without this lap, moisture can enter the walls between adjoining insulation blankets. This is something to discuss with the builder.

Another commonly used vapor barrier in new buildings is polyethylene film in large rolls. The film is applied continuously over the inside face of studs, over the bottom of ceiling joists, and on top of floor joists over a crawl space. Such a film has the advantage of being continuous so the only gaps are where holes are cut for openings such as windows and electrical outlets. These holes should be cut carefully to prevent as much moisture leakage as possible.

It is difficult to add a vapor barrier to existing construction. Often older homes have several coats of oil-based paint on walls, and this may serve as an adequate vapor barrier if you maintain reasonable household humidities. However, the only way to be certain of an adequate barrier is to add a vapor barrier to the walls and apply new paneling or other drywall over the barrier. Attics and crawl spaces can generally be vented enough to carry moisture out, so barriers in floors and ceilings are not as critical as barriers on walls.

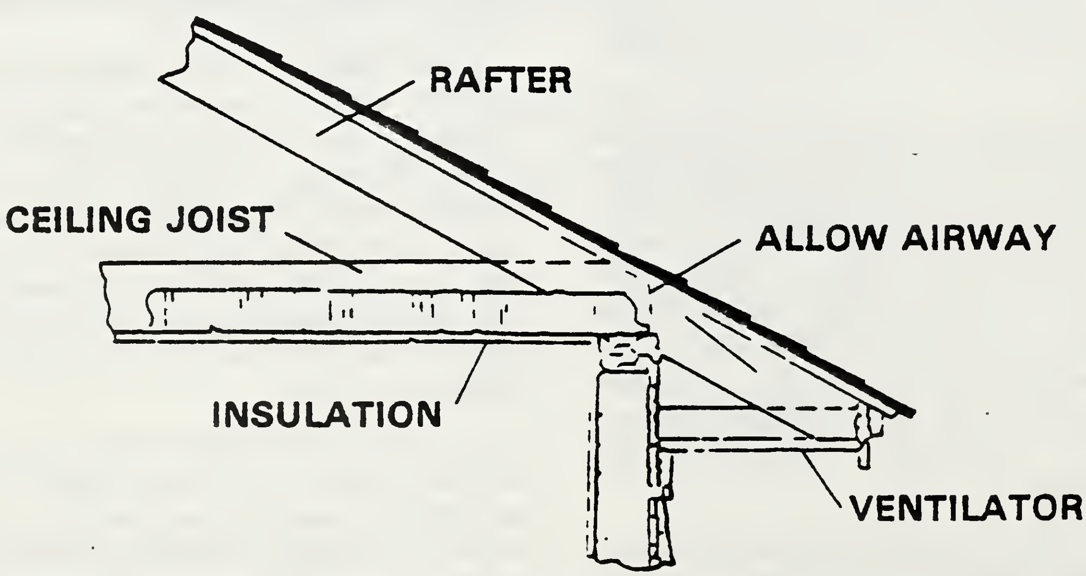


Figure 2. Airway at eave must not be blocked by insulation.

A major source of moisture in houses can be eliminated almost completely by placing a vapor barrier over the soil in a crawl space. This prevents deterioration of floor framing because of high moisture levels, and keeps moisture from moving up through walls and to living areas.

VENTILATION

The main areas requiring ventilation are attics and crawl spaces. In both instances it is necessary to have a good distribution of air movement over the entire area. Attic ventilation is essential. Without it, moisture that moves through the ceiling will be trapped in the attic because most roofing materials prevent moisture from escaping. Flat roofs or cathedral ceilings also must provide for ventilation between the insulation and the roofing.

You can provide attic ventilation with inlet vents distributed along the eave, and with outlet vents near the ridge. Eave vents must not be blocked by ceiling ventilation (fig. 2). Warm air in the attic rises and escapes through the ridge vents; cooler outside air enters at the eaves (fig. 3). Thus, the ventilation is continuous and does not depend on the wind. This ventilation also slows the melting of snow from the roof in cold climates, reducing the possibility of ice dam problems. In the summer, such ventilation reduces buildup of heat in the attic which, otherwise, would cause uncomfortably high temperatures in the house or, at least, higher air conditioning costs. For adequate ventilation, the area of inlet vents each should be at least 1/900th of the ceiling area. Outlet vents also should be at least 1/900th of the ceiling area. Where vents are provided at only one level, such as at gable ends, the total of all the vent areas should be at least 1/300th of the ceiling area.

Crawl spaces should be vented to the outdoors. If the vents are located near each corner, the vents will permit good air movement through the crawl space. The total of all the vent areas where there is no vapor barrier as a ground cover should be at least 1 square foot for each 150 square feet of floor area. Where such a vapor barrier is used, the vent area may be reduced to 1/1500th of the floor area.

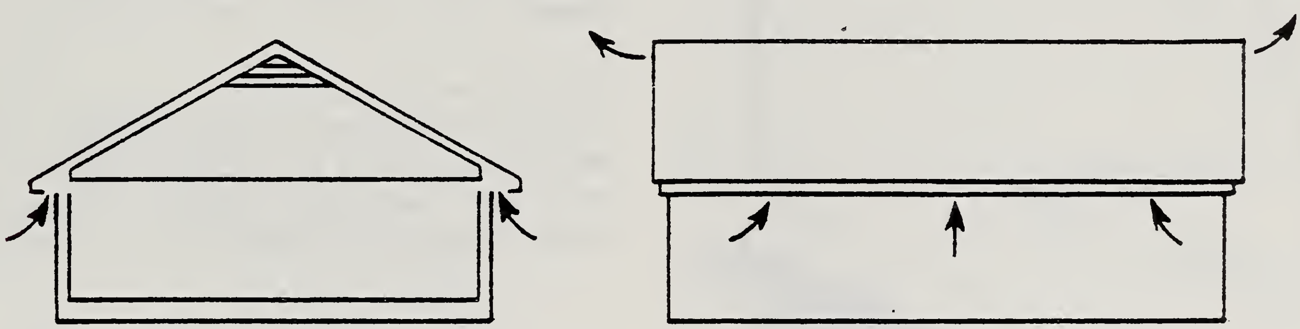


Figure 3. Inlets at eave, outlets at ridge for good ventilation.

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Agricultural Fact Sheet 2 - 3 - 4
United States Department of Agriculture
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Washington, D.C. 20250

May 1978

FACT SHEET

UNITED STATES
DEPARTMENT
OF AGRICULTURE

ENERGY
CONSERVATION
IN THE RURAL HOME

HOW TO SAVE MONEY WITH STORM DOORS AND WINDOWS

You may be able to cut your heating bill in half if you don't now have storm windows and storm doors on your house. Even if you do have storm windows and doors, they might not be giving you the best protection.

This Fact Sheet will show you how to save money on your heating bill—and it will help with summer cooling, too.

The key to success in weatherizing windows and doors is providing a dead air space between panes of glass or plastic (an air gap between ¼ of an inch and 2 inches is satisfactory, but a ¾-inch gap is best). Any of the following methods will be useful in providing this air space.

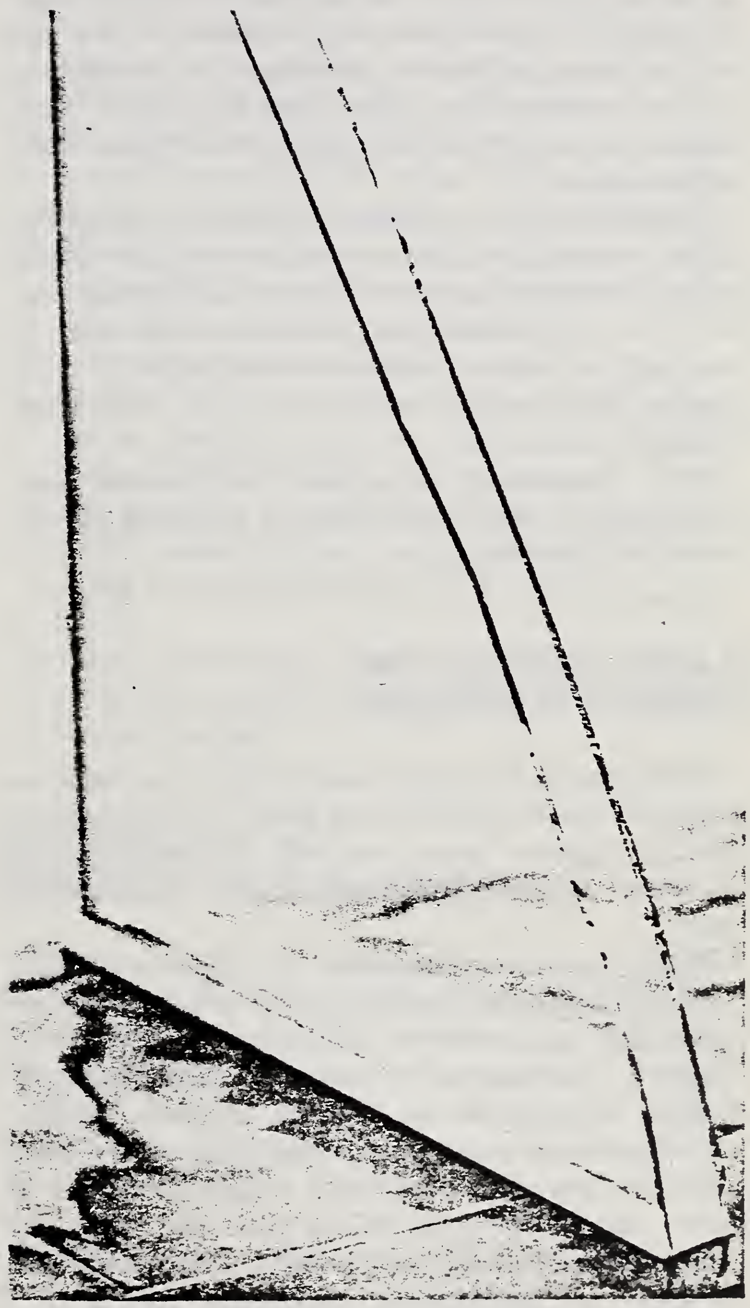
INSULATED GLASS

An excellent permanent solution is to use insulated glass windows (sheets of glass with an air space between) in place of single panes. You can get several good insulated windows on the market. They are the most practical for new construction. Cleaning insulated glass windows is easier than cleaning storm windows; however, insulated glass is more expensive to replace when broken.

STORM WINDOWS

Either prefabricated metal windows or wooden storm windows will do the job.

The metal storm windows usually come completely assembled and ready for installation. You will probably have to make adjustments when you install the windows.



These units usually are displayed where they are sold so you can examine them closely before you buy. If you install your own units, carefully follow instructions from the dealer.

Wooden storm windows are just as useful but require periodic painting and space for summer storage.

Most storm window frames for windows have either two or three tracks for the up-and-down movement of glass and screen inserts. Regardless of the number of

tracks, you should be able to remove all the inserts from the inside of the house.

The triple-track frame allows you to move all the inserts separately to up or down positions. You can also remove them separately from the frame. Although triple-track frames are more expensive, their free movement of inserts does permit you to clean and ventilate easier at either the top or bottom of the window. You can also get frames with inserts that you can tilt in.

In the double-track frame, the screen insert is under the outside top glass insert and supports it. You can raise or lower the bottom glass insert for ventilation. You must remove the screen from the outside track before you can remove the upper outside glass insert from the frame.

Factory-built storm windows or panels for casement, sliding, awning, and picture windows require special designs, depending upon the style of the original window. You can insulate most windows of this type by removing the screen panels and replacing them with glass or plastic panels on the inside of the existing window.

Storm windows also are available for basement casement windows which open either to the inside or outside of the basement.

PLASTIC COVERS FOR DOORS AND WINDOWS

Plastic, can give you the same effective insulation as permanent storm units. You can either use the plastic to cover your present doors, windows, or screens; or you can mount the plastic covering on its own separate fitted frame.

Plastic comes in rolled sheets or is already cut and packaged in kits that include tacking strips, tacks, and instructions for installation. The plastic film varies in thickness, clearness, and resistance to deterioration by sunlight. Polyethylene, for example, is cloudy, flexible, and usually lasts only a year. Vinyl sheets, on the other hand, are clear, flexible, and last from 2 to 3 years in direct sunlight. Polyester film is clear and rigid, but might rattle when the wind is high—it is usually finished in 7-mil thickness and stays clear from 6 to 7 years or longer. Plastic sheets of the same thickness as glass are available and can be effectively used in place of glass; however, it is not nearly as scratch resistant as glass. During the warm months plastic may have to be removed for ventilation.

STORM DOORS

You can get several styles of prefabricated metal storm doors. Pick one that suits the style of your house. Look especially for strength and rigidity of framing. Combination screen and storm doors are popular. Self-

storing glass panels that slide out of the way for ventilation are convenient but will probably cost more.

Buy storm doors with tempered safety glass or nonbreakable rigid plastic to reduce breakage hazards. A grill or bar across the door at the point where your body is most likely to press against the door will also help reduce breakage.

Kickplates at the bottom prevent damage from continued use. Automatic closing devices and strong safety springs are important, particularly in windy locations. Wooden storm doors are equally as effective as metal storm doors if not slightly more so, but they require painting.

COST CONSIDERATIONS

Plastic is the least expensive way to winterize your windows and doors. If you can't afford to do your whole house (whether with plastic or permanent glass units), do the side of the house that faces the prevailing winter winds. If you can afford permanent storm windows and doors, you'll probably find them more economical than plastic ones in the long run. Permanent storm windows and doors, while more expensive, add value to the property. Plastic units do not.

POINTS TO LOOK FOR IN STORM DOORS AND STORM WINDOWS

When you select storm doors and windows, consider the following points:

- The strength of the main frames and frames for the glass or screen inserts is important. Also look for good design to assure easy and efficient handling.
- Look for weathertightness to prevent the entrance of water, cold air, dust, and insects. However, an opening or weep system is standard at the base of all storm windows to release excess moisture.
- You should be able to remove the glass and screen inserts from inside the house. This makes house cleaning easier and requires no outside climbing.
- Think ahead to possible repair problems. Does the dealer offer repair service or can you get replacement parts and do the repairs yourself?
- When you buy new units, check to see that you have all the hardware: hinges, closers, wind chains, locking latches, vinyl base weatherstripping and screws. Check for quality and sturdiness.
- Are materials, workmanship, finish, and assembly under warranty for an adequate period?
- Select the appropriate finish to match your exterior finish.
- When metal framed storm panels are placed on metal storm windows, use a gasket to prevent metal-to-metal contact.

BEST RESULTS IN EXTREMELY COLD CLIMATES

Windows should be constructed with wood frames and sash, and should be fitted with double-sealed glass in extremely cold climates. You can make your own insulated window by sealing in another layer of glass in the sash, with an air space between the two panes. To eliminate condensation problems along the edge of these double-insulating glass panes, you may install storm windows over the outside of the wood sash.

Ordinary storm windows fitted onto the window frames are not suitable for prolonged periods of subzero temperatures. Moisture will condense on the storm window and obscure the glass with heavy frost.

Storm doors and closed entries are desirable for arctic climates. Metal doors with an insulated core and special thermal separators between the inside and the outside shells are especially good for arctic conditions.

HOW TO AVOID MOISTURE PROBLEMS

You'll have less condensation on the inside surfaces of glass panes when you install storm doors and windows. There might be some condensation if you draw drapes or shades at night or if the inside air is especially moist. Remember that while plastic storm covers should be snug, they need not be completely air tight. Weep vents in aluminum storm windows also allow a small circulation or air, thus preventing condensation.

Weatherstripping on sashes of the house windows can prevent moisture condensation inside the storm windows. See your materials supplier for the best materials for your needs. Insulating storm panels or plastic films placed inside the house should be well sealed around the edges to prevent warm damp air from getting between the inside window and the storm window.

OTHER ADVANTAGES OF STORM WINDOWS AND DOORS

- They reduce cooling needs in the summer as well as heating costs in the winter.
- They reduce the noise entering your home.
- They cut down on drafts.
- Self-contained units provide storage space for inserts not in use.

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FACT SHEET

UNITED STATES
DEPARTMENT
OF AGRICULTURE

ENERGY
CONSERVATION
IN THE RURAL HOME

SAVE HEATING AND COOLING DOLLARS WITH WEATHERSTRIPPING AND CAULKING

The time and money you invest in weatherstripping and caulking windows and doors can pay off faster than almost any other home improvement you can make, even when your house is already well insulated. From 15 to 60 percent of the heating or cooling your house needs is due to air exchange. Warming the air that leaks into the house in winter, or conversely cooling the air that leaks into it in summer, takes energy and costs you money. Besides keeping out moisture, wind, and hot or cold air, weatherstripping will block entry to dust and noise, resulting in a cleaner, quieter home. Both weatherstripping and caulking are easy, economical, do-it-yourself jobs.

WEATHERSTRIPPING DOORS AND WINDOWS

Weatherstripping may be purchased by the foot or in handy kits complete with the seal and fasteners for a single door or window. Installation instructions and diagrams are provided on most weatherstripping packages. Some weather seals are surface mounted and are visible, while others are concealed when the door or window is closed. They may be made of a variety of materials.

Self-Adhesive Foam Tapes — High-grade resilient sponge rubber or vinyl with paper or vinyl backing in thicknesses up to three-eighths of an inch and widths up to three-quarters of an inch. Backing is peeled off as tape is pressed in place on door and window jambs, stops, or sash. Surfaces must be clean and dry; should be applied at room temperature for best adhesion. Low cost; easy to install; foams tend to deteriorate when exposed to weather; may last only one season.

Felt Weatherstrip— Low-cost material in various widths and thicknesses. Fasten to wood by tacking or stapling and to metal with a good adhesive. Must be applied to door stop, sill, or sash so it fits snugly against other member. Easy to apply; tears easily during use; not as effective when wet.

Aluminum and Felt Strip— Aluminum strip crimped to thin felt strip provides added strength for tacking and holding to door jambs and window stops. Can be used for round-top doors. Felt may tear during normal use, especially on doors; felt not as effective when wet.

Vinyl Weatherstrip— General-purpose moisture and temperature resistant strip easily applied to wood or metal with tacks, staples, screws, or a good commercial adhesive. Tube-shaped for a tight fit, with extended strip for stapling or bonding to door and window jambs, stops, or sash. Easy to apply; durable.

Sponge Rubber Neoprene-Coated Strip — Round, high-quality durable sponge rubber with a spring steel reinforced strip for attachment. Provides exceptional holding strength when tacked or stapled. For bottom of door, fasten to door; for sides, fasten to door jamb. Also used on windows by fastening to appropriate frame, stop, and sash. Easy to install.

Bronze Weatherstrip— Thin bronze strip in various widths with one side flared out. Tacked to door jamb so when door is closed strip presses against the flared side making a tight fit. Also used for casement windows; not suitable for double-hung windows except at top and bottom. Low cost; easy to install; durable; not affected by moisture or temperature.

Door Bottom Strip— Brass-plated steel crimped to felt or vinyl strip. Fasten to lower edge of door with screws or small nails. Easy to apply; vinyl more durable; felt tears easily and is not as effective when wet.

Weatherstrip and Caulking Cord— Five or six caulking cords in a strip for sealing cracks in windows, doors,

and around room air conditioners. Applied by pressing in place. Cord stays pliable and adheres to any surface. Low cost; easy to apply; durable, not affected by moisture.

Waterproof Weatherstrip Tape— Self-sealing, transparent, durable polytape for sealing cracks in any location. Easy to use by pressing to a clean, dry surface. For windows, tape applied half on stop and half on sash.

Sponge Rubber Door Bottom Seal— Mainly for garage doors, a blend of high-quality sponge rubber that stays flexible at extremely low temperatures. Applied to bottom of door with wide lip outside; if garage floor is lower than driveway, wide lip applied inside.

Air Conditioner Weatherstrip— Rectangular polyfoam that press-fits between the top frame or lower sash and upper pane to seal off the air spaces between window and air conditioners. Low cost; easy to install.

Fiber Glass Insulation Strip— Insulation strip in various sizes used with waterproof tape for closing large cracks around basement and garage doors, windows, and other cold air leaks. Also wrapped around hot water pipes for insulation.

Door Bottoms— Door bottom weatherstripping is available in several materials. While easy to apply, these products can interfere with door swing and require a reasonably level threshold beneath the door. Only simple handtools are required to install any of these door bottoms. After cutting to size with a hacksaw or tin snips, the door bottom is surface mounted to the inside of the door using wood screws normally provided by the manufacturer.

A fairly new innovation in weatherstripping is the mechanically operated "automatic" door bottom. In this model a vinyl seal is automatically lowered against the floor when the door is shut. The seal retracts when the door is opened.

Thresholds— A more attractive method of windproofing the bottom of a door is with a threshold. While most thresholds are effective at cutting down wind infiltration, the average homeowner may find them difficult to install.

A popular threshold is an aluminum model with a flexible vinyl "bulb." When new, this threshold is effective; but under constant use the bulb soon collapses, leaving a sizable crack beneath the door. In most cases the vinyl is replaceable.

Though not the easiest type to install, the combination vinyl door bottom and aluminum threshold is long-wearing and provides effective weatherproofing. Since the vinyl is mounted in an aluminum extrusion fastened to the door, the aluminum threshold bears the brunt of wear.

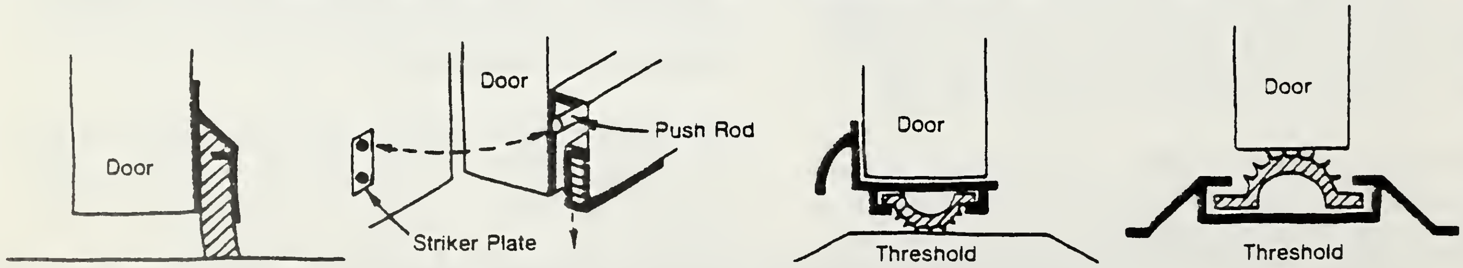
CAULKING

Do-it-yourselfers will find many caulking compounds in a wide range of prices. Most materials are packed in cartridges and can be applied easily with a caulking gun. For large jobs, 5-gallon containers of caulking for guns are used. Manufacturers usually print on each cartridge a description of the material, its performance quality, and directions for application.

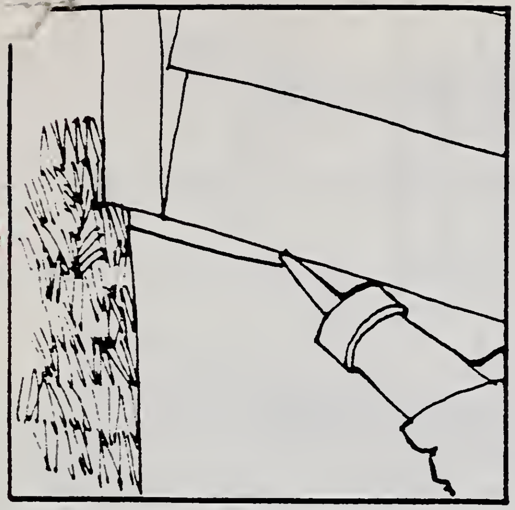
Caulking materials that adhere to wood, glass, metal, plastic, and masonry should be selected since these materials expand and contract. Resistance to weathering, cracking, shrinkage, water, and mildew are also important. Some manufacturers will state the life expectancy of their product if properly installed inside or outside the home.

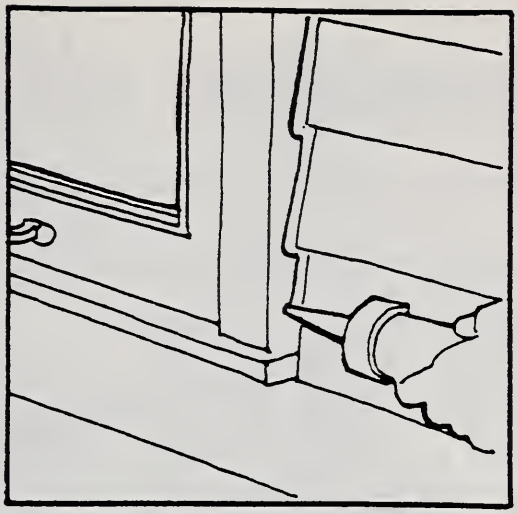
High-quality caulking compounds with a long life expectancy are generally the most expensive. Assuming that the caulking material is used outside as directed by the manufacturer, the following years of useful life may be expected: Silicone—30; polysulfides, polyurethanes, neoprene, acrylic (solvent release), vulcanized butyl rubber—20; acrylic-latex, butyl rubber, and synthetic caulking compounds—8 to 10; cheaper caulking compounds—3 to 5. This is only a partial list and is not meant to exclude any product.

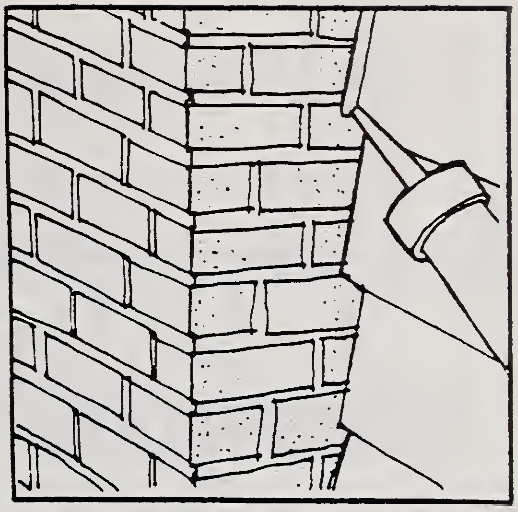
Caulking should not be applied at temperatures below 40° F. It should be installed when temperatures range



Sweep   Automatic sweep   Door shoe   Vinyl bulb threshold







between 45° F and 55° F. At these temperatures expansion and contraction at joints are at a midway point.

Surfaces to be caulked should be clean, dry, and grease-free. Remove dust, loose particles, and old caulking. A steel brush is a good tool for cleaning joints. Refer to the manufacturers' recommendations for caulking large cracks.

Sealing Cracks and Seams—Sealing exterior cracks and seams is an important part of home maintenance. It reduces entry of air, dirt, and moisture into the house and contributes to lower heating and cooling costs.

Among the most important exterior areas of a house requiring attention are:

- Chimney flashing
- Joints between chimney and siding
- Joints between eaves and gable molding
- Joints between window sill and siding
- Joints between window sash and siding
- Joints between window drip cap and siding
- Joints between windows and masonry
- Door frames
- Joints between masonry or concrete parts (steps, porches, etc.) and main part of house
- Inside corners formed by siding

APPLYING SEALING MATERIALS

Follow these pointers for successful application of sealing materials:

- Remove old, dried sealing materials. Clean area with a solvent to remove grease or other substances that would prevent a tight bond.
- Deposit sealing material at the bottom of the seam so it fills without bubbling.
- Never apply sealing material to a porous surface.
- Prime before application.
- Never skimp. Use enough sealing material to fill the crack or seam.
- If sealing material shrinks during drying, reapply.

Fact Sheets In The Home Weatherization Series

1. Why Weatherize Your Home?
2. How To Determine Your Insulation Needs
3. Save Heating And Cooling Dollars With Weatherstripping And Caulking
4. How To Save Money With Storm Doors And Windows
5. What To Look For In Selecting Insulation
6. How To Install Insulation For Ceilings
7. How To Install Insulation For Walls
8. How To Install Insulation For The Floor And Basement
9. Solving Moisture Problems With Vapor Barriers And Ventilation
10. Weatherize Your Mobile Home To Keep Costs Down, Comfort Up
11. Tips On Financing Home Weatherization
12. Keeping Home Heating And Cooling Equipment In Top Shape
13. Landscaping To Cut Fuel Costs
14. Home Management Tips To Cut Heating Costs
15. Locating New Home Sites To Save Fuel

Single copies are available upon request to Special Reports Division, Office of Governmental and Public Affairs, U.S. Department of Agriculture, Washington, D.C. 20250.

This series of fact sheets was assembled from research, Extension, and other sources by the USDA Task Force on Weatherization.

USES AND PROPERTIES OF COMMON SEALING MATERIALS

Material	Recommended Uses	Cleanup Solvent	Shinkage	Adhesion	Remarks
Silicone Household	Seals joints between bath and kitchen fixtures and tile; adhesive for tiles and metal fixtures; seals metal joints as in plumbing and gutters	Dry cloth will remove if area is cleaned up immediately. Use mineral spirits or naphtha	Little or none	Good to excellent	Readily available. Flexibility of cured silicone allows stretch of joints up to three times normal width or compression to one-half the width. Cost: High
Silicone Construction	Seals most dissimilar building materials (i.e., wood and stone; metal flashing and brick)	Same as above	Same as above	Same as above	Remains flexible for life after curing. Permits joints to stretch or compress. Silicones will stick to painted surfaces, but paint will not adhere to cured silicone. Cost: High
Butyl Rubber	Seals most dissimilar materials (glass, metal, plastic, wood, concrete). Seals around windows and flashing, or bonds loose shingles	Use mineral spirits or naphtha	From 5 to 30 percent	Good	Less resilient than silicones. Allows for joint movement but does not become brittle with age. Can be painted after skin forms. Apply when temperature is above 40° F. Cost: High
Latex	Seals joints around tub and shower; fills cracks in tile, plaster, glass, and plastic; fills nailholes	Use water	From 5 to 10 percent	Good to excellent	Easy to use. Seams can be trimmed or smoothed with moist finger or tool. Good water resistance when dry. Can be sanded and painted. Less elastic than above materials. Easy to clean up. Cost: Moderate
Oil-Base Caulks	Seals exterior seams and joints on building materials	Use mineral spirits or naphtha	From 10 to 20 percent	Good	Readily available. Least expensive of the four types. Rope and tube form. Oils dry out and cause material to harden and fall out. Cost: Low

United States Department of Agriculture
Office of Governmental and Public Affairs
Washington, D.C. 20250

ENG 1-5

COOPERATIVE EXTENSION SERVICE

UNIVERSITY OF ARKANSAS Division of Agriculture, U. S. Department of Agriculture and County Governments Cooperating

ENGINEERING AND YOUR HOME

Maintaining a Healthy Crawlspace

Crawlspace is the clearance under a house that has been built on a wooden floor. This crawlspace clearance serves to separate wooden framing members of the structure from the ground, and it allows for termite inspections and access for plumbing repairs. As the word "crawlspace" indicates, adequate clearance for access should be provided. The minimum distance from the ground to the bottom of the floor joists should be 18 inches and 24 inches is more desirable.

Crawlspace drainage and ventilation are absolutely necessary if a house is to remain structurally sound. Water must not be allowed to accumulate under the house, and provisions must be made for air to circulate freely in the crawlspace area. Warning signals are generally observed if drainage and ventilation are inadequate. The observation of water standing under the dwelling is a sure sign of potential problems. Fungus growth on the floor joists is another indication of too much moisture in the crawlspace. Fungus growths generally begin as grey or white powdery spots forming on the joists but may progress to darker, denser masses. These are common in Arkansas; and although they do not deteriorate wood as quickly as termites, they can be just as thoroughly destructive if given several years to work. A sure sign of wood decay is the presence of small mushrooms on the outer surface of the affected material. Drainage and ventilation will generally control mold problems. However, in severe cases it may be desirable to make a chemical application to halt the growth immediately. An application of household bleach (10% strength — 1 quart bleach added to 9 quarts water) will do a good job of killing fungus and mold organisms. Copper sulfate also does an excellent job and has the advantage of having a longer residual than bleach. Two tablespoons of 53% strength wettable powder copper sulfate per gallon of water is a good mixture. Remember that copper sulfate, as well as many other chemicals, is corrosive, so care should be taken when applying copper sulfate around heating and cooling equipment or duct work. Always read and obey the label instructions when using any chemical. Crawlspace moisture can also show up in the living area of a house. Excessive window sweating, mildew, or musty odors can be indicators. Other moisture sources can contribute to these problems, but the crawlspace is an excellent place to begin searching for the cause.

Crawlspace, as well as lot drainage, should be considered when the site for a new home is being prepared. Site preparations should insure drainage away from the structure even after fill dirt for lawns and landscaping is put in place. A good rule of thumb for drainage is to slope all landscaping away from the structure for at least ten feet with a minimum drop of 6 inches. The crawlspace should be kept level with or higher than the finished lawn.

Existing homes that have crawlspace drainage problems can be saved. First, an effort must be made to divert rainfall runoff so it does not flow under the house. If this does not solve the problem, channel potholes of water to one point under the house and gravity drain that spot to a lower point in the lawn or a city storm sewer (4-inch drain tile is generally adequate). If gravity drainage is impossible, collect the water in a depression and pump it out with an automatic sump pump. This should be considered a last resort because of cost and maintenance.

Crawlspace ventilation should be provided at a rate of 1 square foot of ventilation area per 150 square feet of floor area. This generally means one ventilator every 8 to 10 feet around the footing wall. Ventilation requirements can be reduced by covering the ground under a house with a plastic ground cover. Therefore, when a house develops moisture problems because of inadequate ventilation, a plastic ground cover under the house may remedy the problem (a plastic ground cover should not be used under a house that has a standing water problem because the plastic can make the problem worse). Regardless of the size ventilators used or the ventilation rate, at least one vent opening should be provided on each side of the house, preferably near each corner of the structure. Do not close all crawlspace ventilators during winter months. Close only those on the north and west sides and any others that are adjacent to plumbing. Wrap pipes as necessary to prevent freezing.

Any crawlspace that is kept dry by proper drainage and ventilation and is properly treated and routinely inspected for termites should never be the cause for problems in your home.

John Langston

John Langston
Extension Agricultural Engineer

JL:pd

EXTENSION ENERGY CONSERVATION

COOPERATIVE EXTENSION SERVICE/UNIVERSITY OF GEORGIA COLLEGE OF AGRICULTURE/ATHENS

Ventilating Homes During Summer Months

The economics of home air conditioning has caused many Georgians to seek less expensive means to beat the heat. As energy costs rise, more people will seek other means of providing home comfort rather than paying the price of central air conditioning.

Practical Alternatives to Air Conditioning

Other devices can provide reasonable comfort at a lower cost of installation and operation.

Attic fans which are generally installed in the ceiling of a hallway are considered by those in the ventilation trade to be first choice for cooling homes not having air conditioning. These fans draw air through opened windows, draw the air through the home, providing air circulation, and finally exhaust the hotter rising air into the attic. Even hotter air, already in the attic, is displaced by the air from within the home, thereby reducing attic temperatures. Cooler attic temperatures reduce the ceiling temperature slightly, which further increases comfort in the home.

The Home Ventilating Institute recommends an air exchange every 2½ minutes. Using these guidelines, a fan should be sized to move the volume of air in the home in a period of 2½ minutes. Since fans are sized by the air moved per minute, the number of cubic feet of air in the home (floor area × ceiling height) should be divided by 2½ to determine the fan size needed.

Attic fans require one-fourth to one-fifth the energy required by central air conditioning, assuming 88° F. outside temperature and the air conditioner operating 10 hours per day.

The area of the home to receive the greatest air movement can be determined by the openings provided for air entrance into the home. If the bedrooms are to be cooled, for example, open the windows in the bedrooms and close other windows.

Window fans can also provide comfort if installed and used properly. To be effective, the window fan should be installed to make a seal in the window so air can move through the area where the blade operates and not around the fan housing (short cycling).

To be effective, windows should be opened to allow air movement through the house, not through an opening near the fan and then out at the fan.

Floor fans provide air movement within a room and can be placed in a window to bring in cool night air. When using fans of any type, short cycling should be prevented.

Incorporating some good sense can also make homes more comfortable. Use window shades or curtains to block incoming sun. Awnings or roof overhang can also block sun's rays. Reflective film which adheres to glass can repell up to 75 percent of the sun's heat in summer.

Reflective film also acts as an insulator in winter. Some films are opaque when viewed from the outside (burglars can't see inside).

How Does Air Movement Help?

Air movement does more than replace hot air with cooler air. Air moving over the skin causes moisture on the skin to evaporate, giving a cooling effect. To get an idea of the effectiveness of evaporative cooling, place a little rubbing alcohol on the top side of your hand and then blow air over your hand. The cooling effect is very noticeable. Air containing high humidity will not feel as comfortable as dry air because of the evaporative cooling effect. For this reason fans seem to have reduced effectiveness in warm, humid weather.

Does Air Movement Reduce Mildew?

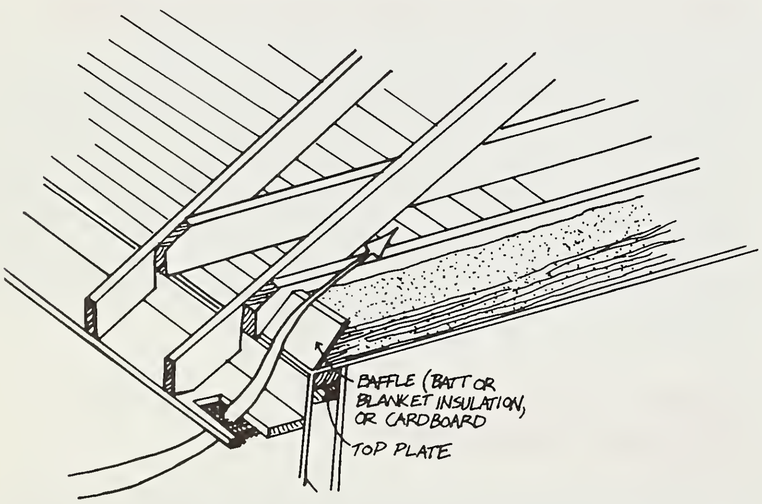
Mildew will grow where the conditions are favorable! A warm, humid environment is most desirable for mildew. It can grow within the home or basement, up in the attic or under crawl spaces.

Ventilation reduces temperature and carries away moisture. Moisture can also be removed in the home with dehumidifiers and air conditioning.

Moisture can be controlled in crawl spaces using foundation vents. In addition, a polyethylene ground cover can be added to prevent moisture rising from the ground. The polyethylene should be lapped four to six inches at the edges and be turned up four to six inches at foundation walls. With a correctly installed ground cover, at least one square foot of vent should be provided for every 1,500 square feet of crawl space, with a minimum of two vents required. They should be located so air flows in one vent through the length of the crawl space and out

the other vent. If no polyethylene is used to cover the ground, a vent needs to be added for every 150 square feet of crawl space. Vents need to be spaced around the perimeter to provide air movement under the floor.

Attic ventilation prevents conditions favorable for mildew growth. The attic can best be vented at the eaves and either at the gables or on top of the roof. In homes with a vapor barrier in the ceiling, combination eave and ridge vents should be sized to have one-half square foot at each eave and one square foot at ridge (½ on each end) for every 300 square feet of ceiling space. If no vapor barrier is in the ceiling, the same is required for every 150 square feet of ceiling space.



Homes without eave vents can be vented through gable vents if they are sized properly. Homes already built which have only gable vents and no vapor barrier under the ceiling insulation should have one square foot of vent area for each 150 square feet of ceiling. One-half the vent area should be at the end of the roof to allow air movement. If a ceiling vapor barrier is provided under the ceiling insulation, as recommended, one square foot of vent area is required for each 300 square feet of ceiling area—again equally divided at each end.

Attic Ventilation and Its Effect On Cost for Air Conditioning

The effects of increasing attic ventilation in order to reduce air conditioning cost has stirred controversy in many areas. According to research at the University of Florida, the reduction in cooling cost as a result of increasing ventilation rate from three air changes per hour (ACPH) (natural ventilation to 12 ACPH) (turbine ventilation) is only 3.4 percent. An additional reduction of 2.2 percent is realized when attic ventilation is increased from 12 ACPH to 24 ACPH (mechanical ventilation system). The same energy-saving benefits which are possible through attic ventilation can be achieved by additional ceiling insulation, provided moisture or mildew is not a problem. If mildew is present, additional ventilation is needed. The ceiling insulation has the added benefit in that it conserves heat energy in the winter as well.

Adapted by Cecil Hammond, Extension Engineer, from a leaflet prepared by the University of Florida.

Grateful appreciation is expressed to the Georgia Department of Energy Resources for contributions made toward the printing of this material.

H & E 4

Miscellaneous Publication 66 **April, 1978**

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, the University of Georgia College of Agriculture and the U.S. Department of Agriculture cooperating.
Tal C. DuVall, Director

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COOPERATIVE EXTENSION SERVICE

ENG 1-5

UNIVERSITY OF ARKANSAS Division of Agriculture, U. S. Department of Agriculture, and County Governments Cooperating

ENGINEERING AND YOUR HOME

ATTIC VENTILATION

Minimum Property Standards (MPS) for attic ventilation require natural ventilation at the rate of 1 square foot of ventilation area per 150 square feet of ceiling area or 1 square foot per 300 square feet if an effective vapor barrier is provided under the attic insulation. Cross ventilation must be provided and at least 50 percent of the ventilation must be located in the upper portion of the attic.

Increasing the amount of attic ventilation above the MPS requirement can result in lower attic temperatures during the summer. A cool attic makes the living area easier to cool, especially if the ceiling is poorly insulated. However, as attic insulation is increased above R-19 (6 to 8 inches), the temperature of the attic has less effect on the living area.

There are points in favor of increased attic ventilation, even if the ceiling is well insulated. First, if the duct system is located in the attic, it will waste less cooling energy when the attic is kept cool. Second, asphalt shingles, especially dark ones, appear to last longer without curling at the edges.

Natural ventilation can be effective in lowering attic temperatures if increased to as much as 1 square foot of ventilation area per 50 square feet of ceiling area. Half of this amount should be under the soffits with the other half as near the roof ridge as possible.

Power ventilators are effective in lowering attic temperatures and are generally sized for at least .7 cfm per square foot of ceiling area. A small amount of power is required to operate these fans, so they become more difficult to justify if large amounts of insulation are used in the ceiling, or if the duct system is not located in the attic. Remember when using an attic ventilating fan, that 80 square inches of inlet area is recommended for each 100 cfm of fan capacity.

John Langston
Extension Agricultural Engineer

JL:tab

SETTING UP AN ENERGY CONSERVATION PROGRAM

By

Clarence Hallmark
Member Relations Advisor

Guadalupe Valley Electric Cooperative, Inc.
Gonzales, Texas

INTRODUCTION

Energy conservation, energy efficiency, energy saving methods, or whatever label one cares to put on the package eventually shows up on the bottom line as "service." Every rural electric cooperative function should have as its top priority the providing of the highest quality of electric energy and other related services. If the "other related services" is omitted, or given a low profile in the organization's objectives, the membership will at best have been rendered an injustice and in some situations might be seriously neglected.

Of course, the final decision concerning the extent to which a cooperative will serve the membership lies in the hands of the Board of Directors. However, a staff which is dedicated to serving the membership is a key factor in the forming of ideas and development of programs which are specifically designed to meet the needs of the members. From the recommendations of the Staff, the Directors approve those policies and procedures which are eventually to become service. A sincere desire to help the membership in electrically related needs and problems should be a natural inclination with every employee of a rural electric cooperative.

WHY THE SERVICE CONCEPT?

The service concept, first of all, is based upon a definite need of the majority of the membership. When such a need exists, and there is no private sector participation to fulfill that need, the cooperative should put forth a determined effort to bridge the gap. Once there is participation from the private sector the cooperative can easily remove its involvement.

Any involvement will require adequate personnel with specialized training (including experience) in the area of service being rendered.

SOME SERVICE PROJECTS

During the early days of the Guadalupe Valley Electric Cooperative, members were experiencing difficulty in acquiring electrical appliances. In response to this need a program was adopted which made it possible for them to purchase and finance certain appliances and equipment through the cooperative. As is true in most every case this service proved mutually beneficial to the organization as well as the membership. Another asset directly related to this type of service, but often overlooked, is the contribution made to sales and the resulting economic growth of the area economy.

In 1953 an employee was hired and given the responsibility of providing power use related information to the membership. From this has developed the present Member Services Division which includes a staff member and fifteen employees.

In 1955 the Board of Directors adopted an All-Electric Home Rate which provided an excellent service for members who had electricity as the only energy in the home. The goal in those days was to provide an opportunity for members to purchase energy at one cent per kilowatt-hour.

The cooperative also provides an Appliance Service and Repair Shop. This service was initiated in 1969 in order to assist members who were having difficulty in getting appliances and equipment serviced. This was

made necessary by the reluctance of appliance dealers to make service calls in the rural areas. Presently three employees and two service vehicles are required to handle this work. This is a self-sustaining activity. Approximately 200 invoices are processed each month, and clerical assistance is provided for taking calls, ordering parts, maintaining inventory records, and billing. Some 1,300 different types of parts are stocked at a cost exceeding $30,000. It should be noted that the two other major services (Ceiling Insulating and Insulating Windows) presently being made available by the cooperative have each had their origin in connection with the Appliance Service and Repair Shop.

When the high cost of energy problems began in 1973 it became evident that there was a greater need for home insulation. The cooperative's Member Services employees had been encouraging this conservation measure for almost 20 years. However, as energy costs accelerated upward members were faced with the problem of finding a contractor to handle installing the insulation. The only insulators available were in the large cities some 75 miles away. Mileage and travel time contributed to exorbitant charges and many members simply could not afford to have their homes insulated. To supply this need, an insulation blowing machine was purchased and rock wool insulation was placed in stock. By mid-1973 this service was in operation on a cost-plus basis in order to provide the lowest possible prices for the members and at the same time give the cooperative sufficient margins to keep the program on a sound financial basis. Financing was also offered with payments spread out over a period of up to 12 months.

When a contractor who had been handling the insulation jobs became interested in going into the business, the equipment was sold to him. By mid-August, 1978, the two-million square foot mark had been reached with more than 1420 jobs performed. Free job estimates are provided by one of the three Member Services Advisors. Only ceiling insulation service is provided.

Early in 1977 a Window Insulation Program was instituted. Again this grew out of a need on the part of the members for additional energy conservation practices. As a result of this decision, GVEC was immediately able to assist members who desired to participate in the Home Weatherization Loan Program when it became available through the Farmers Home Administration on a national basis. At the end of September, 1978, 2,108 insulating windows had been installed in 185 homes.

CARRYING OUT THE PROGRAMS

Possibly the greatest difficulty experienced by a cooperative in initiating any service is the procuring of qualified personnel. Every service is a specialized effort, and without trained employees the task of providing a service can involve much confusion and difficulty.

Facilities for handling the service are also a major factor. For example: The GVEC Board of Directors approved the establishing of the Appliance Service and Repair Shop in mid-1968. Plans for the program were developed, and in 1969 the shop was constructed in the cooperative's headquarters building. All major in-house servicing is done in this shop. Also, a rate schedule of charges for transportation, labor, and material

was established. Office space was needed for a clerk to handle the work orders, inventory records, job scheduling, and billing which was necessary.

Parts and materials are another factor in the providing of a service to the membership. Consideration must be given to quality as well as safety. Workmanship is especially important in the manufacture of such items as insulating windows. An in-house system for locating and identifying any parts which are kept in stock is highly desirable. The parts and material will also involve facilities for storage.

Vehicles and equipment are another necessity. These must be out-fitted, and in some cases customized, in order to realize maximum performance from them.

Contacts with dependable suppliers are also very important in the providing of the various services.

A cooperative interested in providing any energy conservation service should consider the following minimum requirements:

(See Page 6)

	APPLIANCE SERVICE AND REPAIR SHOP	CEILING INSULATION SERVICE	INSULATING WINDOW SERVICE
Trained Employees	1-Appliance Service Man 1-Appliance Repair Man	1-Insulation Technician 1-Helper	1-Insulating Window Technician 1-Helper
Facilities	16' x 24' Shop	50' x 100' Insulation Storage Area	20' x 50' Window Storage Area
Vehicles	1-Service Van (fully equipped)	1-Insulation Blowing Machine 1-Towing Vehicle	1-Service Pick-up with special rack for transporting windows
Hand Tools	As required	As required	As required
Parts	Wholesale Parts Firms	Rock Wool Insulation Manufacturer	Insulating Window Manufacturer (must be custom-built)
Monthly Inventory	$35,500	$18,000	$19,500
Back-Up Personnel:			
Clerk°	Same	Same	Same
Member Services Advisors*	NA	3	3

°Clerk handles clerical work for all three services

*Member Services Advisors take attic and window measurements, make recommendations, and prepare job estimates for members

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by: Clarence M. Hallmark
Member Relations Advisor
Guadalupe Valley Electric Cooperative, Inc.
October 3, 1978

ENERGY CONSERVATION

"WE'RE DOING IT"

Report To

REA

by

BALDWIN COUNTY ELECTRIC MEMBERSHIP CORPORATION

SUMMERDALE, ALABAMA 36580

Prepared By:

Bob Willis

Member Information Representative

CONTENTS

EXHIBITS

"WE'ER DOING IT"

I. WHAT A RURAL ELECTRIC COOPERATIVE SHOULD DO IN AREAS OF ENERGY CONSERVATION.

Every cooperative has the responsibility to their members to keep them informed on the latest Energy Conservation methods. With the publicity given now to conservation by President Carter, Rural America should once again be leading the way. Every means should be utilized. Newspapers, Radio, Statewide Newsletters, or magazines. From the standpoint of the member, not only will conservation aid the Nation's depleting resources, but also help to hold the line on their own energy usage. There are areas in which an electric cooperative can take action - one is in the field of their own control such as load management and the other is in the field of technical and fundamentals to its members. At Baldwin County E.M.C. we have devoted most of our time, talents, and money to the latter.

A. What Should Be Done Concerning Load Management?

1. It may be necessary to take positive steps in load management. We recently held a demand school and conservation class for our large power accounts. We are currently having feasibility studies made to determine what type of load controls are available and best suited for the needs of the Cooperative. We recently installed capacitors at all substations due to the KVA Ratchett Billing rate structure of our power supplier.

2. Office Conservation Policy (internal):

(Attached you will find a copy of Board Policy No. 31 dealing with Energy Conservation.)

BALDWIN COUNTY ELECTRIC MEMBERSHIP CORPORATION

SUMMERDALE, ALABAMA

Board Policy #31

ENERGY CONSERVATION

I. OBJECTIVE

To establish policy concerning use of energy by the cooperative and its members, particularly in regard to effectiveness, efficiency, and conservation of energy. This objective is consistent with the utility responsibilities of a full-service cooperative and its prime concern for members' needs.

II. POLICY

It shall be the policy of Baldwin County Electric Membership Corporation to:

A. Constantly examine its own use of energy. This includes, but is not limited to, plant engineering design and construction, lighting and climate control and use of vehicles.

B. Develop and carry out a system-wide program of energy management including energy conservation, adequate home insulation, weatherization, efficient irrigation and other farm and business uses, and effective and efficient use of energy in the home. Alternate energy sources will be appropriately considered.

C. Develop and carry out an information program so that the need for energy management is understood along with understanding of what each consumer can do to meet energy use needs most effectively.

D. Develop and carry out an information and education program with major groups involved in housing, including the building industry and local government organizations, to assure understanding and coordination in methods of energy management.

E. Develop training as appropriate for all employees.

F. Develop an adequate program to promote the weatherization of members' homes, including the selection and monitoring of contractors and securing adequate financing from the FmHA, local lending institutions, National Rural Utilities CFC and other sources.

III. RESPONSIBILITY

It shall be the responsibility of the General Manager to develop work plans and budget recommendations to carry out this policy and to develop appropriate control reports to assess results.

BY ORDER OF THE PRESIDENT

George W. Engel

Attest: Raymond N. McMillan

Raymond N. McMillan, Secretary-Treasurer

Date Adopted: 7-19-78

B. Technical Advice and Assistance Given! How Much?

1. Energy Audits (See Exhibit No. I)

An energy audit is available for all members homes. Member Services personnel will check for insulation needs (attic, walls, raised floors, ductwork condition, return vents, check filters, examine windows and doors for air infiltration, hot water heater thermostat setting, etc. We list on a priority basis items needed to aid home for greatest return in investment.

FmHA Weatherization Program - (1) Newspaper Ads - (See Exhibit II)

(2) Radio Commercials - (See Exhibit III)

(3) Area Magazine - (See Exhibit IV)

2. Construction of Energy Saving Homes

New members building homes are referred to the Member Services Department, where their questions are answered directly on insulation and any other energy conservation building methods.

3. Pamphlets

Available (in sight displays) at all three offices! Rack type displays are located in the front office at the main office complex and at the two district offices. Included are different types of energy conservation materials.

4. Display Energy Conservation Room (See Exhibit V)

We have a room at the main office set aside as an energy conservation headquarters. Featured are a heat pump displayed by local contractor; storm windows and storm doors; different types of insulation on the market such as fiber glass, foam products, cellulose products, and T.G. grade styrofoam. Printed Materials from different insulation contractors are on display for members to pick up. Also - hot water heater with a hot water heater insulation kit.

5. Model Home (Scale)

We have built a scale model Energy Saving Home for display at this year's Baldwin County Fair and to be displayed at the main office. Features latest energy saving building methods . Walls show different types of insulation available and how to install it, plus vapor barrier. Perimeter insulation is shown also. A complete kitchen and laundry room shows energy saving appliances and the ECU Unit. A model heat pump is also installed.

6. Open House

Held Open House to show features of energy saving home. Over 300 came by during the 4 hour Open House (Foy Home)

(a) Stressed ECU (Energy Conservation Unit)

(b) Did a two hour live remote on local radio station promoting the energy home.

7. Wiring Inspection Program for Last Eight Years

Adequate wiring assures members of no loss by poor wiring. We also provide a Preferred List of Electricians as a service to the membership. Good safe wiring means energy conservation.

II. On april 14, 1977, Baldwin County E.M.C. became the first Alabama rural electric cooperative to sign up for the Farmers Home Administration Weatherization Loan Program. This program authorizes Baldwin County E.M.C. to process loans for the purpose of weatherizing homes for qualified BCEMC members. Baldwin County E.M.C. representatives met with local contractors and suppliers on May 12 and June 14, 1977, to inform them of the program and the impact that we felt it would have on their business and the savings for our members. As a result of these meetings we have enjoyed enthusiastic support from those contractors and suppliers since the inception of the program. Baldwin County E.M.C. has compiled a list of qualified weatherization contractors

for referral. In June of 1977 BCEMC initiated an intensive advertising campaign to promote the Weatherization Program and its benefits. The campaign utilized the following medias: three weekly newspapers; three bi-weekly newspapers; three radio stations; and the monthly AREA Magazine with a circulation of 15,000. We have utilized this campaign continuously since 1977. We have enclosed an Energy Audit Request Coupon for the member to fill out and return in the AREA Magazine. Baldwin County E.M.C. also advertised the program in the centerfold of the 1977 Annual Report.

Baldwin County E.M.C. representatives have met with local bankers in an effort to promote financing for members who cannot qualify for the Farmers Home Administration Weatherization Loan; however, these financing institutions were not interested in offering competitative interest rates for the Weatherization loans.

Baldwin County E.M.C. personnel attended two Statewide training sessions to gain an insight into the mechanics of the Farmers Home Administration Loan Program. We also attended workshops dealing with the mechanics of performing an energy audit.

To date BCEMC has received 128 requests for Energy Audits, 116 have been completed. BCEMC has processed 16 loans. Over fifty members financed weatherization of their homes through other means. Twenty to twenty-five members that BCEMC performed energy audits for plan to initiate steps to weatherize their homes themselves as soon as possible. Insulation for the do it your self members has become a scarce commodity in the Baldwin County E.M.C. service area during the past three months. Baldwin County E.M.C. made a survey of the local weatherization contractors to obtain the following information:

Since July of 1977, approximately 500 homes have added attic insulation, 50 have added wall insulation, 100-150 have installed storm windows and caulked windows. We feel that many of these homes were weatherized either directly indirectly as a result of the promotion of the BCEMC Weatherization Program. As of the August 31, 1978 unofficial summary of Rural Housing Activities, Rural Electric Cooperative's Weatherization Program, provided by FmHA, BCEMC is shown to be a member of District 5. As a member of this district, we have processed $12,505.60 in loans which is more than half of the loans that have been processed in the entire State of Alabama.

III. USE OF ENERGY SAVING APPLIANCES

Counseling service available through Member Services Department. We have held demostration classes on microwave ovens in conjuction with the county extension service personnel and have had energy saving appliances on display at our Annual Meeting for the last two years. Tried to educate the members on what to buy. For example - the heat pump verses resistance heat. I believe in the future the Co-op members will be looking to their cooperative to tell them which type appliances will be the best to buy. We want to have the expertise and knowledge to properly advise when they ask.

A. Our Member Services Department provides Heat Gain Heat Loss calculations on new homes - recommending energy saving equipment.

B. Our Member Services Department is constantly trying to stay informed on Energy Saving Appliances. The purpose is to keep the membership informed - whether it is a good or bad appliance.

IV. WHAT IMPACT (ONE TO ONE) WILL THIS HAVE ON MEMBER RELATIONS?

Every energy conservation program entered into by Baldwin County E.M.C. is geared with the one to one aspect in mind. We all know that direct contact with the member is the best possible way to educate them on sound energy conservation. The following are a few of the programs we have initiated with this idea in mind.

A. Fair Booth - (See Exhibit V)

Nineteen seventy eight (1978) Baldwin County Fair - Over 10,000 Baldwin Countains attended the week long fair. Over three thousand came by the BCEMC booth. Displayed were a heat pump and ECU unit; different types of insulation; and our scale model energy saver home. Energy Conservation booklets were given out. Employees were on hand to answer any questions.

B. Annual Meeting

Mr. James Hall, State Administrator of Farmers Home Administration was an invited guest and spoke concerning the Weatherization Loan Program offered by FmHA and the Cooperative. Again the objective was made to the member to conserve! Mr. Hall spoke at the Annual Meeting in 1977. References were made to this program during the 1978 Annual Meeting also.

C. Tent

Displays - Insulation Contractors - In July 1977 a large tent on the Annual Meeting site contained ten different displays on conservation theme. Included were several insulation contractors, a storm window and door contractor, a microwave oven display along with a home economist who demonstrated several cooking techniques. Old and new electric appliances were also shown.

D. School Program

A 45 minute slide presentation is presented to all 6th grade students - school classes in the service area - each year. Included in the program are various slides showing ways of conserving energy. Main items include recommended thermostat settings winter/summer, keeping doors closed, living habits, etc. Items the children can relate to. Energy pamphlets are given to each student to take home.

E. During a recent period of high KWH consumption this past winter, the Member Services Department went to many homes personally to explain

the cause, rates and the extreme cold, of the high bills. Methods of conserving energy were discussed with the member in an effort to educate them on the need for conservation. This was supported by advertising in all local papers, radio spots, and on the bi-monthly radio program.

F. Presented Programs to Civic Groups in the Area

Staff personnel are always available to speak at any service organization or club meeting to discuss any phase of the energy question or conservation practices. A series of programs are currently in progress for the minority and elderly groups in our service area. Programs deal mainly with economical conservational ideas.

G. Co-Op Enlightner (See Exhibit III)

Cooperative has a 15 minute radio program on each radio station in the service area which is aired every two weeks. Energy conservation and load control methods are discussed and explained as a part of each program. Spot announcements are also used from time to time.

H. Meter Reading Contest - Promotion (See Exhibit IV)

Baldwin County E.M.C. participated with the Statewide organization by way of the AREA Magazine in a campaign to bring more awareness to the members on what causes their energy usage. Prizes were awarded statewide plus we added extra promotion locally and added additional prizes as an incentive to participate. We received hundreds of entries from the members which included readings for an entire month. A great purpose was attained. Each member reading his meter everyday for a month enabled him to see first hand how his energy usage was affected by the weather, air conditioning, extra company, cooking, washing, and average daily usage. We were so pleased with the daily meter reading promotion that we repeated it in January 1978 during a cold weather month.

I. Informational Meetings

Three meetings for members are being held during October 1978 and November 1978 in different communities in the Co-ops service area. These meetings deal with rates, general information, and energy conservation ideas.

J. Area Magazine

Statewide newspaper used to keep members in touch with Co-op. We at BCEMC believe in the AREA Magazine and in using it to its fullest. Each month we try to include some type of article which reminds the members to conserve in some manner. It is the best way we have and the most economical to reach the total membership.

We feel at Baldwin County Electric Membership Corporation that we are meeting the members needs on conservation at this time. The Board of Trustees and Management does not intend to rest on past laurels. We will continue to seek new programs and methods to help our membership conserve energy.

BALDWIN COUNTY ELECTRIC MEMBERSHIP CORPORATION

SUMMERDALE, ALA. 36580

ENERGY AUDIT

NAME ______________________________ DATE ____________

ADDRESS ______________________________ CITY ____________

LOCATION# ____________________ EQUITY # ____________________

HOUSE

Type ____________________ Age ________

No. Sq. Ft. ____________________

Insulation: Type

Attic ____________________ ____________________

Walls ____________________ ____________________

Floor ____________________ ____________________

Windows:

Type ____________________ Const. # ____________ Sq. Ft. ________

Condition - Good _____ Fair _____ Poor _____

Doors:

Type ____________________ Const. # ____________

Weatherstripping - Good _____ Fair _____ Poor _____

Roof:

Type ____________________

Ventilation:

Natural ______________ Forced ______________ Turbine ________

Adequate _______ Inadequate _______

Fireplace:

Damper ______________ Adequate ____________ Inadequate ____________

Plumbing Leaks:

Sink ____________ Laundry ____________ Tub ___________ Shower ____________

Well Pump:

Waterlogged ____________________ Leaks ________________________________

Refrigerator:

Gasket - Tight ______________________ Replace __________________________

Condenser - Clean ___________________ Needs Cleaning ___________________

Freezer:

Gasket - Tight ______________________ Replace __________________________

Condenser - Clean ___________________ Needs Cleaning ___________________

Heating System:

Type _______________________________ Size ____________________________

Air Conditioning:

Type _______________________________ Size ____________________________

Duct System:

Insulation - Adequate _______________ Inadequate _______________________

Size - Adequate _______________ Inadequate _______________________

Fabrication -Adequate _______________ Inadequate _______________________

Returns - Adequate _______________ Inadequate _______________________

Filter Condition - Clean ____________ Needs Replacing __________________

Air Distribution - Adequate _________ Inadequate _______________________

Thermostat Setting:

Heating _______________ Cooling ________________

Lighting:

Type ____

Range Hood:

Damper _______________________ Proper Fit ______________________________

Water Heater:

Thermostat Setting ______________

Condition of Insulation - Adequate____________ Inadequate __________

RECOMMENDATIONS:

____

____

____

____

____

____

____

____

____

____

(Signed)________________________________
BCEMC Representative

WHEP

ESTABLISHED 1953

SERVING PROSPEROUS BALDWIN COUNTY, ALABAMA

Firm Baldwin County Electric Membership Corp. Salesman

Date 8/15/77 Spot Number

(Please Remember, Somebody Must Read What You Write)

PLEASE DOUBLE SPACE

ATTENTION.....BALDWIN COUNTY ELECTRIC MEMBERSHIP CORPORATION MEMBERS.... YOU'VE BEEN HEARING A LOT LATELY ABOUT THE NEED FOR ENERGY CONSERVATION....HERE IS ONE REAL FACT..... AS THE NATION'S NATURAL RESOURCES DWINDLE, THE COST OF ENERGY WILL CONTINUE TO RISE.... SO THE NEED FOR CONSERVATION HAS NEVER BEEN SO APPARENT.... WHAT CAN YOU DO? BALDWIN COUNTY EMC HAS WORKED OUT A PLAN WITH THE FARMERS HOME ADMINISTRATION TO ENABLE YOU TO HAVE YOUR HOME WEATHERIZED AND HAVE IT FINANCED THROUGH YOUR COOPERATIVE FOR UP TO FIVE YEARS, IF YOU QUALIFY. FIRST, YOU MUST BE A MEMBER OF BALDWIN COUNTY EMC AND THE HOME TO BE WEATHERIZED MUST BE ON THE COOPERATIVE'S LINES..... YOU MUST HAVE AN ADJUSTED FAMILY INCOME OF LESS THAN $15,600 A YEAR.... AND IN NEED OF FHA CREDIT.... AND YOU MUST HAVE GOOD CREDIT WITH THE COOPERATIVE..... INTERESTED?.....THEN CONTACT ANYONE IN THE MEMBER SERVICES DEPARTMENT AT SUMMERDALE OR LEAVE YOUR NAME, ADDRESS, AND PHONE NUMBER WITH ANY OFFICE OF BALDWIN COUNTY EMC AND A REPRESENTATIVE WILL CONTACT YOU.

WHEP

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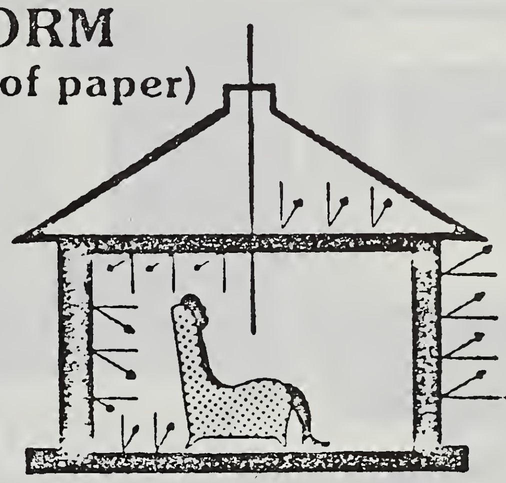
ATTENTION.... BALDWIN COUNTY ELECTRIC MEMBERSHIP CORPORATION MEMBERS.... NOW YOU CAN HAVE AN ENERGY AUDIT PERFORMED ON YOUR HOME TO SEE WHAT TYPE OF ENERGY SAVINGS STEPS CAN BE TAKEN TO SAVE ON YOUR ENERGY USAGE.... A REPRESENTATIVE OF BALDWIN COUNTY EMC WILL COME TO YOUR HOME AND DO AN ENERGY AUDIT....CHECK CONDITION OF WINDOWS AND DOORS, AMOUNT OF INSULATION IN THE HOME, HOT WATER HEATER CONDITION, DUCT WORK DESIGN AND CONDITION, ATTIC VENTILATION, PLUS SEVERAL OTHER ITEMS CONTRIBUTING TO YOUR ENERGY USAGE....THEN, AFTER THE AUDIT IS MADE, YOU MAY DECIDE TO TAKE ADVANTAGE OF THE NEW WEATHERIZATION LOAN AVAILABLE TO YOU AS A COOPERATIVE MEMBER....YOU MAY QUALIFY FOR A WEATHERIZATION LOAN OF UP TO $1500.00 AND TAKE UP TO FIVE YEARS TO REPAY....FIRST, YOU MUST BE A COOPERATIVE MEMBER AND THE HOUSE TO BE WEATHERIZED MUST BE ON THE COOPERATIVE'S LINES, YOUR ADJUSTED FAMILY INCOME MUST BE LESS THAN $15,600 A YEAR....INTERESTED? ....THEN CONTACT ANY OFFICE OF BALDWIN COUNTY EMC, LEAVE YOUR NAME, ADDRESS, AND PHONE NUMBER, AND A REPRESENTATIVE WILL CONTACT YOU.....

Energy Savings Sweepstakes!

OFFICIAL ENTRY FORM
(or you may use a plain sheet of paper)



C. S. Scott
Name

Rt. 1 Box 169
Address

Uriah Alabama
City-State

36480
Zip

Baldwin County E.M.C.
Name of Co-op

DATE	METER READING	DAILY AMT. USED	DATE	METER READING	DAILY AMT. USED
Aug. 1	67700	65	Aug. 17	68843	52
Aug. 2	67763	63	Aug. 18	68913	70
Aug. 3	67819	56	Aug. 19	68976	63
Aug. 4	67862	43	Aug. 20	69070 * 2 air conditioners	94
Aug. 5	67904	42	Aug. 21	69111	41
Aug. 6	68003 * 2 air conditioners	99	Aug. 22	69150	39
Aug. 7	68081	78	Aug. 23	69190	40
Aug. 8	68159	78	Aug. 24	69229	39
Aug. 9	68275 Cleaned oven 3½ hr. * 2 air cond. all day	116	Aug. 25	69258	29
Aug. 10	68345	70	Aug. 26	69290	32
Aug. 11	68407	62	Aug. 27	69380 * 2 air conditioners	90
Aug. 12	68491	84	Aug. 28	69451	71
Aug. 13	68556	65	Aug. 29	69510	59
Aug. 14	68637	81	Aug. 30	69600 * 2 air conditioners	90
Aug. 15	68720	83	Aug. 31	69680	80
Aug. 16	68791	71			

Ask yourself each day:
1. How many kilowatt hours have I used since yesterday?
2. What did I do with this electricity?
3. How could I have saved electricity?

Mail Completed Form to:

Alabama Rural Electric
Association of Cooperatives
P. O. Box 7120
Montgomery, Alabama 36107

* Must be Mailed by September 10, 1977

EXHIBIT V

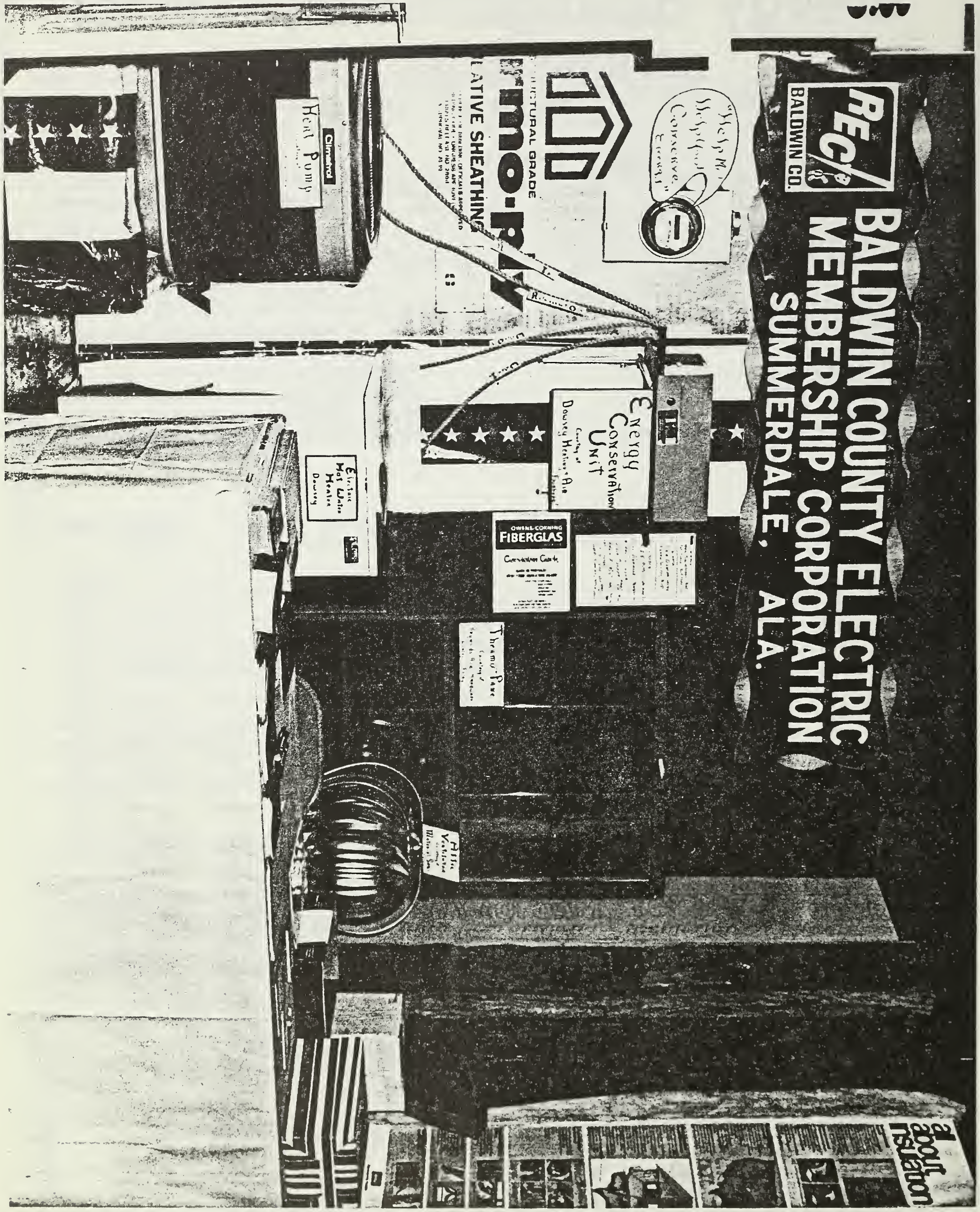

REC
BALDWIN CO.
BALDWIN COUNTY ELECTRIC
MEMBERSHIP CORPORATION
SUMMERDALE, ALA.
Energy Conservation Unit
Heat Pump
Climatrol
OWENS-CORNING
FIBERGLAS
STRUCTURAL GRADE
all about insulation

EXHIBIT VI - A

Baldwin Times

Winner Of 112 Awards For Journalistic Excellence

ving: Bay Minette, Bell Fountain, Crossroads, Douglasville, Lottie, Loxley, Perdido, Pine Grove, Rabun, Rosinton, Stapleton, Stockton, White House Forks.

Monday, June 13, 1977 10 Pages

Baldwin County EMC To Help Homeowners With Insulating

By Jesse Winder

President Carter's energy program will affect Baldwin County EMC members right where it counts the most - in the pocketbook.

"Before last winter, $250-$300 utility bills were beyond comprehension for people in this area." said Leon Richardson, director of the Member Services Department of the BCEMC. "Much of our time during the winter was spent visiting people, explaining why their bills were so high. We experienced very bad public relations."

Richardson explained that residents had practically ignored insulation and other energy saving measures in the past, due to the mild climate.

"We wanted to find a way to help members 'weatherize' their homes." he continued. "President Carter's plan to finance home energy-saving measures through the Farmer's Home Administration fit in perfectly. The loan would be added on to a member's light bill, to be paid off in five years at eight percent interest."

The Co-op is pleased that the program will give them a chance to deal directly with members. It works like this: If a BCEMC member would like to reduce utility bills by weatherizing his home, he can call the Co-op and they will send someone out to do an 'energy audit' on the house. That will determine exactly what measures (i.e. weatherstripping, insulation or storm windows) can best be used to curtail energy consumption. If the applicant's adjusted income is no more than $15,600 he may borrow up to $1500 to weatherize with five years to repay the loan.

If more is needed members may apply for the home remodeling program. If 62 years or older they may apply to the County EMC Supervisor for an outright grant.

After the energy audit, BCEMC will present a list of contractors to the homeowner from which he may choose one to do the work. The BCEMC will fill out all the paper work.

If a member defaulted on the loan, the Co-op would not be liable. Neither would they cut the member's lights off. The case would be turned over to the Government, which in turn would kick it down to the county supervisor. Henceforth, all dealings would be with the supervisor. The Co-op merely administers the FHA program.

The present target date is July 1, 1977. The Co-op expects to spend some $2,000,000 in weatherizing 3,500-4,000 Baldwin County Homes.

"This doesn't mean that if your thermostat was set at 68 last year, now you can turn it up to 74." Richardson warned. "If a member does what we recommend, the savings themselves will pay for the loan. We're still pushing conservation as the best measure, like we have for the past four or five years. It just took last winter to make people listen."

The "FOLEY ONLOOKER"
June 16, 1977

'Weatherizing' help from EMC

By Jesse Winder

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EMC Outlines Energy Plan

:SSE WINDER
ourier Correspondent

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Loan Program On Weatherization Set By Baldwin EMC

A PROGRAM WILL be held at 12:00 noon, July 1, at Lovell's Restaurant in Loxley for the purpose of introducing insulating contractors to Rural Housing Weatherization loan program, and an agreement between Farmers' Home Administration and Baldwin County Electric Membership Corporation.

A simplified way to finance home weatherizing improvements has been arranged by the U.S. Department of Agriculture through its Farmers Home and Rural Electrification Administrations (FmHA and REA), in cooperation with the National Rural Electric Cooperative Association.

Under this plan, homeowners eligible for FmHA rural housing credit, who are served by rural electric co-ops, like the BCEMC, may have home weatherizing work done through their co-ops, and pay by easy installments on their monthly electric bills.

Homeowners in Baldwin need to deal only with the BCEMC in Summerdale to secure this service.

The local co-op will receive applications from homeowners for home weatherizin work to be financed by FmH loans and will advise appli cants what weatherizing wor can be done to improve thei homes.

Additionally the EMC wil refer applicants to availabl qualified contractors who ca do the work, and pa contractors who can do the work.

Payment will be stretched out for homeowners over a five year period by the co-op by adding a small monthly installment on the borrower's regular co-op electric bill.

Certain eligibility requirements must be met, such as a member-consumer of rural electric co-op, live in rural countryside or rural town of not more than 20,000 population and be within limits of moderate family income.

Better weatherproofing of homes is an action all American homeowner families can take to help conserve fuel and energy, cut the cost of home heating and cooling, and prevent discomfort or hazards to health brought on by severe winter cold waves or summer heat.

SIOUX VALLEY EMPIRE ELECTRIC ASSOCIATION, INC.
Colman, S.D.

Director of Member Services & Energy Conservation

I. Position Objective

The Director of Member Services & Energy Conservation is a department head reporting directly to the General Manager and shall be accountable for the development, implementation and administration of all member services and energy conservation programs carried on by the Cooperative. The director must subscribe totally to the Cooperative's philosophy and objectives regarding energy conservation and energy utilization services for its members. Member needs must be monitored and determined and programs and activities designed to effectively meet those needs must be developed and implemented. As a member of the General Manager's immediate staff, the director must be able to participate effectively in General Staff meetings, serving as a source of information and perspective to the General Staff and to the people in the department. Also, the director will be expected to provide information, advice and assistance to the General Manager relative to departmental needs and developments and on their overall effect on the objectives and goals of the Cooperative.

II. Position Responsibilities

The Director of Member Services and Energy Conservation shall function as follows, within the limits of existing board policies, operating guides and procedures, approved work plans and budgets and specific delegations from the General Manager.

A. Planning

1. Develop and recommend long and short-range plans for the department, an annual departmental work plan and budget which includes the programs, activities and goals to be accomplished by the department, organization structure requirements, resources needed and the control system and communicates plans necessary to achieve desired results.

B. Organization

1. Develop and recommend the organization structure of the department, including plans for the transition from the present member services oriented structure to the structure required to carry out the much broader scope of the department as energy conservation and related programs are implemented. The director will be guided primarily by existing board and management operating guides and procedures regarding staffing, salary administration and morale and motivation.

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C. Direction

1. Directs all of the activities of the department and delegates certain responsibilities and authorities with the recognition that he is accountable for all activities and developments within the department, interprets responsibilities and authorities to his staff as required.

2. Performs personally such activities for which the department is responsible that cannot better be performed by someone else in the department. Recognition should be given that new programs and those involving sensitive member concerns should receive his careful and personal attention.

D. Control

1. Keeps intimately aware of the overall energy needs of the members for residential, farmstead and commercial uses and interprets these needs in terms of new or different programs and activities.

2. Monitors costs, participation and member reactions to existing member services programs, develops and recommends changes or improvements to increase their effectiveness.

3. Conducts surveys, makes personal contacts and utilizes other means to clearly determine member needs and point of view.

4. Keeps informed of the results of research and development projects in energy-related areas, interprets these results in terms of possible application and utilization by the Cooperative.

5. Monitors progress and costs incurred in carrying out departmental work plans and budgets, prepares regular reports to the General Manager and interprets them in terms of exceptions from plans and the need for replanning.

E. Relationships

1. Internal

a. General Manager - Works closely with the General Manager as a member of his immediate staff, secures his advice and counsel and advises and assists him through information, reports and candid expressions of his point of view.

b. Other Department Heads - Participates as a member of the General Staff, cooperates and coordinates activities with them and facilitates interdepartmental cooperation and coordination.

c. Other employees - To communicate with them and obtain mutual understanding and cooperation.

2. External

a. Members & Consumers - To develop an intimate awareness of, not only the members' energy-related needs, but their point of view regarding Sioux Valley's performance and role in assisting them to achieve a better life.

b. Allied organizations - To keep informed of, and exchange information relative to, activities and developments in the member services and energy conservation area.

c. Research and Development Organization - To keep informed of, and to secure interpretations of, energy-related developments and products.

d. Educational Institutions - To keep informed of the applicability of training programs being conducted in the energy field and to determine the results of their research and development projects.

e. General Public - To maintain friendly, cooperating relationships in all his contacts and to serve whenever possible in public and community affairs.

III. Organizational Relationships

A. Responsible to: General Manager

B. Accountable for: Electrical Advisors
Home Service Advisor
Wiring & Service Personnel
Energy Conservation Personnel

JOB DESCRIPTION

TITLE: Energy Advisor

REPORTS TO: Member Services Director

PURPOSE:

To consult with consumers, home builders, and others regarding load management, energy efficiency, proper construction requisites for new and existing homes. Handle member/consumer complaints and inquiries.

DUTIES AND RESPONSIBILITIES:

1. Inspect existing residential construction and advise as to retrofitting for improved energy efficiency.

2. Inspect new residential construction and recommend to home owners, builders and others regarding construction problems and improvements that will increase energy efficiency.

3. Arrange, schedule, and distribute educational, and promotional material and brochures for exhibits, home show, fairs, etc.

4. Research billing historys and consult with consumer on billing inquiries after routing handling procedures have not satisfied their complaint.

5. Acquire and interpret information related to energy consumption and efficiency for consumers, home builders, and others.

6. Answer telephone inquiry's from consumer, regarding co-op energy conservation policy procedures, etc.

7. Keep abreast of technical and energy-saving features of new products and developments in the energy, home-building and appliance industries.

8. Make speeches and present programs for schools, civic clubs, churches and professional groups.

9. Work with 4-H Clubs, FFA, Scouts and other youth groups to promote energy education.

10. Perform other related duties as directed.

SPECIFICATIONS:

Education: Associate degree in Electrical Engineering, Technology or equivalent experiences.

Others: Valid driver's permit.

Occupational combination of verbal ability to speak before group and communicate with people of varied culture and educational backgrounds. Ability to solve basic math problems; should be familiar with housing construction techniques and terminology, basic electricity and appliances. Initiative, diplomacy, and tact required in dealing with people.

A Guide to be Adapted to Local Circumstances

POLICY # ________

________ Electric Cooperative

I. Objective: To establish policy concerning use of energy by the cooperative and its members, particularly in regard to effectiveness, efficiency, and conservation of energy. This objective is consistent with the utility responsibilities of a full-service cooperative and its prime concern for members' needs.

II. Policy: It shall be the policy of ________ Cooperative to:

A. Constantly examine its own use of energy. This includes, but is not limited to, plant engineering design and construction, lighting and climate control and use of vehicles.

B. Develop and carry out a system-wide program of energy management including energy conservation, adequate home insulation, weatherization, efficient irrigation and other farm and business uses, and effective and efficient use of energy in the home. Alternate energy sources will be appropriately considered.

C. Develop and carry out an information program so that the need for energy management is understood along with understanding of what each consumer can do to meet energy use needs most effectively.

D. Develop and carry out an information and education program with major groups involved in housing, including the building industry and local government organizations, to assure understanding and coordination in methods of energy management.

E. Develop training as appropriate for all employees.

F. Develop an adequate program to promote the weatherization of members' homes, including the selection and monitoring of contractors and securing adequate financing from the FmHA, local lending institutions, CFC and other sources.

III. Responsibility: It shall be the responsibility of the General Manager to develop work plans and budget recommendations to carry out this policy and to develop appropriate control reports to assess results.

Date Approved: ______________ Attested: ______________
Secretary

THE DEVELOPMENT OF AN ENERGY MANAGEMENT PROGRAM AT BLUE RIDGE ELECTRIC MEMBERSHIP CORPORATION

The Blue Ridge Electric Board of Directors has, for many years, done corporate strategic planning and has kept this plan updated annually. Under objectives and strategic goals, a section is called "energy conservation, efficient use of energy and alternate energy sources." This section reads in part, "to effectively use the resources of the cooperative to promote energy conservation, adequate home insulation and weatherization, and viable alternate energy sources; and provide necessary technical assistance to members to enable them to realize substantial reduction in energy usage and to take advantage of alternate energy sources that would result in economic benefit to the members and help relieve the critical energy shortage."

Over the last four or five years, this assistance to the membership in energy conservation has been primarily an educational communication program. In almost every issue of Blue Ridge Electric's monthly information bulletin to the members there has been information on how members can conserve energy. In 1975, a program was developed called HELP (Home Energy Limiting Program) that brought all the communications information under one umbrella. Included in the HELP program were information brochures, insulation standards, assistance to home builders and contractors, working with building inspectors, and an awards program to homes meeting the HELP standards. This program was originally designed at new construction, but was later modified to include existing buildings.

By 1977, it was obvious and desirable for the cooperative to do more for their members than just supply information. This opportunity came about in March, 1977, when Blue Ridge Electric was contacted by the United States Department of Agriculture and was requested to be one of the chartered cooperatives to sign and take part in the Farmers Home Administration weatherization loans. These loans would make it possible for members to borrow money up to $1,500 over a five-year period at, then, 8% interest. The cooperative would do all the paper

work for the loan process. At approximately the same time, at a systemwide women's conference, sponsored by Blue Ridge Electric, a resolution was passed that stated "we request that the Board of Directors of Blue Ridge Electric Membership Corporation provide a housing specialist to work with members on an individual basis to help them know what they need in insulating or better insulating their homes, how much it would cost, how to get it done and how much energy savings they would have." This resolution was unanimously agreed upon by the women at the conference and, when placed before the Board of Directors, was passed unanimously. With this type of input from the membership, coupled with the starting of the Farmers Home Administration loan program, the time was right for the cooperative to move out on establishing a full energy management program.

The Executive Vice President was then directed by the Board of Directors to develop and implement such an energy management program.

The Organizational Planning and Personnel Services Department of Blue Ridge Electric was then tasked with the job of making recommendations for the necessary organizational changes and personnel requirements to establish an energy management section.

At approximately this same time, in May of 1977, a Member Opinion Survey, conducted by the cooperative, indicated 89% of the members surveyed stated that the cooperative should provide assistance in determining adequate insulation needs.

The Organizational Planning and Personnel Services Department recommended that a highly qualified staff position should be created in the Member and Public Relations Department to provide functional guidance to the energy management program. This position would report directly to the Manager of Member and Public Relations. The other recommendation was that a position be created in each of the four districts in the Member Relations Section of that district. These positions would be titled Energy Conservation Specialist and would be manned by personnel highly

trained in energy conservation methods, available to work in the office or in the field.

With these decisions made, the next step was to develop position guides and specifications for the two new positions. Also developed at this time was the purpose and functions of the Energy Management Section (the purpose and function of the Energy Management Section is attached. Also attached is a copy of the position description for the Director of Energy Management and the four Energy Conservation Specialists).

There being no like position in the organization or in local industry, specifications for salary levels, equipment needs and support services had to be ascertained before a budget could be completed. Tough questions had to be answered with little background, such as:

a. Transportation needs (car or truck)

b. Equipment needs (what type of equipment)

c. Should the co-op own vehicles?

d. What are sources of training?

e. At what pay level could we expect to attract the top people that would be needed in this program?

Within the next two months, these questions were answered. Information was put out all over the Blue Ridge Electric area and in other areas of North Carolina. Interviews were held and by the first of July, five new employees came on board.

The major areas that these four people would be working on were: (1) information within Blue Ridge Electric to Directors and employees on energy management.

(2) Member education in energy management.

(3) Technical advice to builders and homeowners.

(4) Information and assistance to the housing industry.

(5) Provide financing for members with the Farmers Home Administration plan.

Training programs were instituted immediately, using industry representatives

whenever possible, home inspection check sheets were developed and refined. Various information on insulation was sought from all sources.

Armed with this information, the Energy Conservation Specialists were educated, trained and practice their inspection skills and were off and running.

In the first six months, they conducted over 350 home inspections, two complete county school systems, numerous office buildings, churches, fire departments, community buildings, libraries and post offices. All Blue Ridge Electric buildings were inspected and energy management procedures instituted. The Energy Conservation Specialists and the Director of Energy Management were in great demand for presentations to various civic and local groups, reaching over 1,000 people in the first 6 months.

A continuous training and updating program has been instituted because of the rapid changes in this field. Blue Ridge Electric, being one of the first in the field, had to continuously answer inquiries of other cooperatives and organizations and in doing so furthered their own knowledge of the area. Blue Ridge has been instrumental in starting a chapter of the Home Builders Association in each of the four major counties served by the cooperative. This has strengthened the communication link between the cooperative and the building industry.

Energy management is a continuing process and the Energy Management Section is striving to remain up to date in order to better serve the members of the cooperative.

PURPOSE AND FUNCTIONS Date Adopted: April 18, 19

The Energy Management Section is one of the sections of the staff department of Member and Public Relations Department. As a major staff section of this department, this section has the responsibility for planning and providing professional and technical guidance and control in all key result areas assigned to the section. The section is responsible for developing for the department technical information, practic procedures, resource materials, guidelines, and manuals necessary to achieve uniformity of effort, and for carrying out compliance audits which will assure desired results in the functional areas assigned the section.

The section exists to meet the following needs:

PURPOSE: To develop and implement programs which provide service to the members that will enable them to most effectively and efficiently make use of available energy, including alternate energy sources.

MAJOR FUNCTIONS OF THE SECTION ARE:

1. Internal Education On Energy Management: To develop and implement programs of information and education for directors, employees, and member committees which will gain understanding of need for and how the Cooperative will carry out its energy management program to assure positive support and effective assistance in the implementation of the program.

2. Member Education On Energy Management: To develop and implement programs of information and education for members of the Cooperative, to create an awareness of need for the energy management program, including conservation, adequate insulation and weatherization and viable alternate energy sources, and motivate them to develop an energy management program for themselves.

3. Technical Advice And Assistance: To develop and implement a program which will provide for the members the guidance necessary to assure they can realize the best savings possible in energy usage and to take advantage of alternate energy sources that would result in economic benefit to the members and help relieve the critical energy shortage.

4. Information And Assistance To Major Groups Involved In Housing: To develop and implement a program which will assure that all major groups involved in building construction are informed and support energy conservation and weatherization programs and work is done in accordance with specifications approved by the Cooperative.

5. Financing Home Weatherization For Members: To develop the necessary program to assure that members are able to secure necessary financing to weatherize their homes at reasonable interest rates. (Program to include FmHA Financing Plan.)

PROGRAM OF

ENERGY CONSERVATION - HOME WEATHERIZATION
AND
ALTERNATE ENERGY SOURCES

OBJECTIVE

To effectively marshal and use the resources of Blue Ridge Electric Membership Corporation within budget limits approved by the Board of Directors to promote energy conservation, adequate home insulation and weatherization and viable alternate energy sources; first with the employees and directors and corporate operations, and then all members of the Cooperative, and provide the necessary technical assistance to enable each of these groups to realize substantial reductions in energy usage, and to take advantage of alternate energy sources that would result in economic benefit to the member and help relieve the critical energy shortage.

To initiate the achieving of this objective, the Organizational Planning and Personnel Services Department is requested to recommend to the Executive Vice President the necessary organizational changes and personnel requirements in

(1) The Member and Public Relations Department, where it is expected a staff position will be added to provide functional guidance to the program, and

(2) In the districts where it is expected a reassignment of personnel will result in a person working fulltime in this area.

It is further requested that the Department take the initiate to provide assistance in structuring the function of these new positions, position descriptions, and recruiting.

Executive Vice President

3/31/77

POSITION GUIDE

PART I - POSITION IDENTIFICATION

730

Position Title: Director of Energy Management

Personnel Dept. Review ____________

Department : Member and Public Relations

Incumbent ____________

Approved by: ______________________________
(Reviewing Supervisor)

Date Adopted: April 18, 1977

PART II - POSITION PURPOSE
(Summary Statement of Principal Objectives of Position)

1. To develop, direct and implement an energy management program, including energy conservation, adequate insulation, and weatherization, and viable alternate energy sources with members, employees, and directors of the cooperative to meet system objectives in conservation and effective use of available energy sources.

2. To provide staff services to the districts, and other system personnel as appropriate, in the area of training and information relating to total energy management, energy conservation and viable alternate sources of energy to assure system program is being implemented and agreed on results achieved.

3. To exercise staff control in all areas of responsibility to assure system needs are met and compliance with approved programs related to energy management obtained.

4. To advise and assist the Department Manager by planning, developing and recommending sound programs, budgets, and developing practices in functional areas assigned to the position and providing reports and information regarding progress and developments so that the department and system objectives are met.

PART III - AUTHORITIES AND RELATIONSHIPS

Reports to: Manager of Member and Public Relations

Supervises: None (Exercises Functional Authority through Staff Role)

Has full and complete authority to carry out the responsibilities delegated to this position; making all decisions necessary within the limits of budgets, policies and system practices. Has functional authority in all areas of delegated responsibility to get action and to implement changes.

Relationships - Internal and External: Shall maintain inter and intra departmental relationships and external relationships necessary to achieving the purpose of this position and agreed upon work results for the section.

1. Develop and implement system-wide program of energy management including energy conservation, adequate home insulation, weatherization and effective and efficient use of energy available including alternate energy sources.

2. Develop and carry out an information program with directors and employees that will gain their understanding and commitment to an energy management program for the membership of the cooperative.

3. See that an adequate information program is developed and carried out with the members of the cooperative and the general public that will gain their understanding of why an energy management and conservation program is needed and what they can do to meet their own needs for effective use of energy.

4. Develop and carry out an information and education program with major groups involved in housing, including but not limited to architects, building suppliers, builders and contractors, lending institutions and governmental bodies to assure need for energy management and conservation programs, use of alternate energy sources are understood and methods for conservation, weatherization and securing adequate home insulation are properly utilized.

5. See that employees who will be implementing energy management programs are properly trained and have the necessary information to meet member needs as it relates to energy conservation, use of alternate energy sources, adequate home insulation, weatherization and other areas affecting the use of energy.

6. Maintain necessary resource contacts with schools, colleges, research organizations, building trades, manufacturers, lending institutions, and governmental agencies to assure current information is maintained on the state of the art in all aspects of energy management including conservation, insulation, weatherization, etc., and the applicability of alternate energy sources and see that such information is shared on a timely basis with the employees, members and public.

7. Administer the total energy management program for the cooperative, including conservation, the HELP project, weatherization, use of available alternate energy sources to assure the best possible results for the member-consumers.

8. Develop necessary system practices and procedures in all areas of energy management, making sure they are consistent with system policies. Take necessary action, including communication and training, to assure that these practices are administered and carried out by system personnel to achieve best results for the cooperative.

9. See that all programs administered by the cooperative meet or exceed building code requirements.

10. Establish and maintain the necessary professional contacts to keep up, personally, with progress being made in energy management and to assure exchange of information.

11. Study and research in all areas of responsibility. Make evaluations and implement changes within delegated authority and make recommendations for changes in areas outside delegated authority to assure the best energy management program for the cooperative.

12. Develop annual system goals in energy management program in consultation with district and member relations department personnel.

13. Assist Department Manager in the development of long range (2 - 5 years) goals for the energy management program.

PART IV - MAJOR TASKS (cont'd)

14. See that an adequate program of financing is developed to meet member needs in weatherization and adequately insulating buildings to include the FmHA program, local lending institutions and other sources which will result in the best interest rates for the member.

15. Develop a program of controls and measurements for the personnel in districts who are carrying out the energy management program and the necessary system of inspections and audits to assure follow-thru and effectiveness of programs.

16. See that all programs developed in areas of responsibility are implemented throughout the cooperative.

17. Develop and implement controls and reports to be used in evaluating costs and measuring progress toward meeting responsibilities of the position and attaining stated goals.

18. Provide staff (professional) guidance in all areas assigned to assure personnel carrying out program understand the program and the methods of implementation.

Education: Four-year college degree desirable. Emphasis in business management preferred. However, will consider individuals with either a business administration, architectural, engineering, and/or liberal arts educational background. Closely related job experience may substitute for part or all of educational requirements. Specific vocational preparation in home building (construction methods, building codes, insulation materials and methods, etc.) highly desirable.

Knowledge & Skills: Must possess thorough knowledge of residential and commercial energy utilization and conservation principles, residential and commercial construction methods and building codes, insulation materials and insulating techniques, and electric heating and air conditioning equipment.

Knowledge of alternate energy sources desirable for hiring/mandatory for full implementation of position.

Must be an effective speaker and writer (English language) to carry out internal and external, written and oral communications responsibilities with employees, directors, members, building contractors, architects, government institutions, colleges and universities.

Must be able to develop and effectively administer the cooperative's practices and procedures for a home weatherization program, including development and implementation of a financing program.

Must have a demonstrated ability to effectively exercise functional (staff) authority, with requisite interpersonal skills (human relations and motivational techniques, etc.).

Experience: Work experience with an electric utility or regulatory commission desirable, but not mandatory. Must possess demonstrated management expertise - 3-5 years (minimum) experience in staff (functional) project management and/or program planning and supervisory position.

Additional experience as teacher/instructor/job trainer desirable.

Physical Characteristics: No specific physical requirements.

Exempt Status: This position is exempt from the overtime requirements of the Fair Labor Standards Act, as amended - administrative definition.

Non-Discrimination: This position, shall be filled solely on the basis of the individual's qualifications for this position and without discrimination on the basis of race, color, religion, sex, age, national origin, handicap, or veteran's status.

Position Level: This is a middle management position. This position is responsible for the execution and interpretation of policies throughout the organization, in assigned areas of responsibilities, and for the successful operation of certain responsibilities assigned the Energy Conservation Specialist(s), MRD'S, and the District Managers. This position has a high degree of responsibility for individual initiative and judgment, acting under policies and directives of top management. This position has the responsibility for recommending new or revised policies and for establishing objectives and goals for the energy management function for the cooperative. Results will be generally accomplished through the District Energy Conservation Specialist(s), MRD'S and District Managers and others. The staff function of energy management (programs) is assigned this position.

PART I - POSITION IDENTIFICATION

Position Title: Energy Conservation Specialist Personnel Dept. Review__________

Department: District

Reports to: Member Relations Director Incumbent__________

Approved by:__________ Date Adopted: April 18, 1977
(Reviewing Supervisor)

PART II - PURPOSE OF POSITION
(Summary Statement of Principal Objectives of Position)

1. To carry out those activities which will meet member needs in the areas of energy management, to promote energy conservation, adequate insulation, weatherization and viable alternate energy sources,providing the necessary technical assistance to enable members to make the most effective and efficient use of energy, obtain desired results and reach system and district goals.

2. To see that members are aware of and have available to them adequate financing to provide for adequate home insulation and weatherization.

3. To see that insulation and weatherization work meets established system standards.

4. To provide guidance to members, builders and contractors, insulating firms and other persons affecting the quality of the insulation and weatherization of buildings to assure good work is done.

5. To carry out a continuing education program with employees, members, the public and organizations involved in the building and insulating trades to assure they understand the energy situation and the best methods of energy conservation and use of alternate energy resources.

6. To see that members are informed on a continuing basis about general energy conservation measures and results they can expect when these measures are put to use.

PART III - AUTHORITIES

Within approved policies, practices, work plans, system programs and budgets of the cooperative the Energy Conservation Specialist is held accountable by the Member Relations Director for the following activities and is granted the authority to:

1. Carry out the energy management program for the district, subject to staff guidance and the limitations set forth above.

2. Process loan papers for FmHA loans for district members.

3. Advise and inform members of other financing available for insulating and weatherizing their buildings and interest rates payable under these plans.

4. Advise and inform members, on their premises if necessary, concerning what is needed to properly insulate and weatherize their buildings, giving them guidance as to how the work might be done, how much it should cost, and what they can expect in the way of energy savings and the potential savings in dollars.

5. Provide information and guidance for general building contractors and insulating firms relating to specifications for the HELP and the weatherization programs approved by the cooperative.

6. Inspect member's building once it is insulated and/or weatherized to assure it meets cooperative's standards.

7. Maintain contact with persons and firms in the housing business or building supply business to assure they have current information on energy conservation methods and materials as well as alternate energy sources.

8. Provide information to employees on a systematic basis to assure that they are fully aware of the energy situation, the need for conservation of energy and are taking measures to conserve energy at home and at work.

9. Provide information to members and the general public relating to the energy situation to assure understanding regarding the shortage of energy and what they can do to help conserve energy and make use of alternate energy sources.

10. Provide technical assistance to farms, homes, businesses and industries relating to methods of energy conservation and uses of alternate sources of energy.

11. Handle member follow-up when high bill inquiry or complaint indicates problem may involve conservation measures.

12. Keep current information on methods of conservation available and be knowledgeable of resource assistance available to Energy Conservation Specialist and to employees, members and organizations in the housing trade regarding new methods, materials, appliances, etc., and share information with these groups.

13. Get energy conservation ideas from employees and members and see that these ideas, where practical, are utilized inthe system's energy management program.

14. Keep district employees informed on the system's energy management program and seek feedback from all employees on how well the program is accepted and utilized by the members and what the results with the members are.

15. Provide information, articles and pictures, for the "ALONG (District) LINES" and "EMPLOYEE CHATTER" to assist in promotion of the energy management program.

16. Keep the Member Relations Director informed in all areas relating to the Energy Conservation Specialist's work.

17. Provide background information to system personnel when they are assigned to assist in the district energy management work.

18. See that program is carried out in accordance with staff directives and when problems develop, provide feedback to supervisor and staff director.

19. Do necessary day by day planning and scheduling with supervisor to assure best utilization of time with maximum contacts and benefits to the members.

PART V - JOB REQUIREMENTS

Education: Should be a high school graduate or equivalent. Post high school formal education very desirable (degree not required). Must have sufficient facility with the English language to be able to effectively communicate orally and in writing with individual members, with groups of members in a group leadership role, and with employees.

Knowledge and Skills: Must be able to deal effectively with the public and present a good member and public relations image to all consumer-members. Must be able to effectively administer the cooperative's energy conservation policies and practices. Must be (or become) thoroughly familiar with the cooperative's energy conservation and home weatherization programs, including residential and commercial building methods, building codes and insulation materials and techniques. Must have sufficient knowledge of financing methods to administer weatherization financing program and execute loan agreements.

Experience: Experience as a customer service representative for an electric or gas utility (or equivalent face-to-face contact with consumers) very desirable.

Physical Characteristics: Must be in good general physical and emotional health. May be physically handicapped, but not in such a manner as to prevent carrying out of job responsibilities. (Inspection function of position requires close examination of attics, basement crawl space,etc., of existing homes and buildings, and new homes and buildings under construction.)

Exempt Status: This position is exempt from the overtime requirements of the Fair Labor Standards Act, as amended - administrative definition. This job will require attending and conducting night meetings on a periodic basis without additional compensation.

Non-Discrimination: This position shall be filled solely on the basis of the individual's qualifications for this position and without discrimination on the basis of race, color, religion, sex, age, national origin, handicap, or veteran's status.

IMPROVING MEMBER RELATIONS BY AN ENERGY CONSERVATION PROGRAM

By Wally Beyer, Manager
Verendrye Electric Cooperative, Inc.

Verendrye Electric Cooperative serves a 134 township area in parts of 7 counties in North Central North Dakota. The cooperative is included in a 10,000 degree day area. 6,500 members receive electric service over 4,100 miles of our distribution line, this line is connected through a sub-transmission grid with 20 distribution substations.

Our power supply is a thermo-hydro mix from the Department of Energy and Basin Electric through our transmission cooperative Central Power Electric Cooperative. Wholesale power costs at the low side of our distribution substations currently average 1.7¢ per KWH. Average costs at the consumer's meter are presently at 3.3¢ per KWH. Projections indicate 5.5¢ per KWH and higher costs at the consumer's meter in 1985.

Cost escalations in generation facilities in our area drive the point home. In the 1960's installed capacity costs were $136 per kilowatt. A generation facility presently under construction will cost an estimated $900 per KW. Additional problems result from new power plant production setbacks. As a result, future power shortages become obvious. Energy shortages with ever increasing rates indicate a definite need for an energy conservation program.

What does energy conservation and member relations have to do with all this? Polls indicate that most folks don't believe that there is an energy shortage. Through a comprehensive energy conservation program there is a continuous member learning process besides the obvious cost saving benefits.

There is no better way to improve member relations in the conservation area than by practicing what we preach. Setting a new direction is our Board of Director's "Energy Conservation Policy", in effect for over a year.

The first phase of a three-year program to totally weatherize our office building is in effect. Window areas are being reduced, new insulated shop doors are being installed and ceiling insulation levels are being increased. A solar water heater installation is in the planning for 1978. This unit will serve as a demonstration project in our area in addition to supplying hot water for our main office building.

Economy pickups and cars are being phased in and utilized wherever possible. For jobs such as staking and for meter reading these vehicles work out very well. In line with reducing transportation costs, Verendrye is developing plans to reduce driving time. Multi-phase meter reading routes are being planned with part-time help from members in outlying and remote areas.

Another popular system program is the employee's car pool. Although only in operation for one year, it is the talk of the town with the upcoming winter season.

Verendrye even went as far as to change out all office hall lights from 100 watt bulbs to 40 watt limits. Although the financial implication is minuscule, the psychological impact is very significant to the visiting member and more important, the employee. Not only do all these efforts drive the conservation point home, they demonstrate to the membership an efficiently run operation.

Verendrye Electric presently has a sound consumer conservation program and would not be without it. The members want, need, and often demand it. Initial organizational steps included expanding the Member Services Department. A new qualified and dedicated Member Services Director was hired with developing a conservation program as a priority portion of his job description. A new set of building recommendations with "absurdly" high insulation levels was developed. Our extremely cold winters and 1985 power cost projections dictated drastic changes now. Most consumers are very anxious for any and all the help they can get when planning a new home. Additional help is given in the form of design and utilization of heating systems. Member Services does a heat loss calculation room by room considering window types, basic construction and insulation levels for the total home. Once wattage requirements are found, it is an easy matter to come up with annual heating cost estimates, heating cost projections and available savings as a result of off-peak heating.

Verendrye also offers all members a complete home weatherization program. When the Farmers Home Administration came along with a loan program, we joined with "great guns". For the members who do not qualify for FmHA financing, Verendrye's general funds are available at similar interest rates, payback periods and the like. Member Services has organized a list of approved contractors and will help get the work done right. An inspection visit is made whenever needed. This program is very popular with participating consumers. One particular member is quoted at saving 37% of the previous year's heating bill, "We spent $1400 on weatherization, and it sure is paying off".

Additional assistance is offered in the form of home energy audits. Whenever a member is uncomfortable in his home or with his heating bill, Member Services will visit that home free of charge. At that time it is decided where best a member can spend weatherization dollars and save the most in the long run. If need be, the loan papers and arrangements are made on the spot. Another popular service in the area of high seasonal bills is the availability of monthly budget billing.

It is obvious that a considerable new work load has been added. Another new full time man has been hired to basically handle this load. Part-time help is also utilized the year around. New expansion in the area of manpower is also planned for next year.

Other consumer programs include the expansion of our Member Advisory Committee. They are utilized in planning area informational meetings, the annual meeting and other consumer related activities. This group is also instrumental in organizing our member-read 3 Ø meter routes.

Verendrye is very receptive to "talking" conservation wherever possible. The members want to hear and know everything possible. In the past couple years Verendrye has held an average of twelve area informational meetings. Statewide REC Magazine center pages also play an important monthly role. This on-going member education procedure will definitely continue.

Maybe the largest impact that Verendrye's membership has felt in the conservation area stems from the adoption of the flat rate. We felt there was a definite need to move away from the promotional declining block rate. After all, the declining block rate is designed to reward consumers for large consumption. That definitely does not help members conserve energy. How can you sincerely preach conservation with promotional rate schedules? Under our flat rate, it doesn't make any difference whether you use 10 KWH or 10,000 KWH, the cost per KWH is exactly the same. The majority of the membership accepted the change with open arms. In our judgement, the membership wouldn't allow a reversal back to the promotional rate. We have received many favorable comments from the membership including, "this is a fairer approach for the small consumer", and "it should have been set up this way in the first place!"

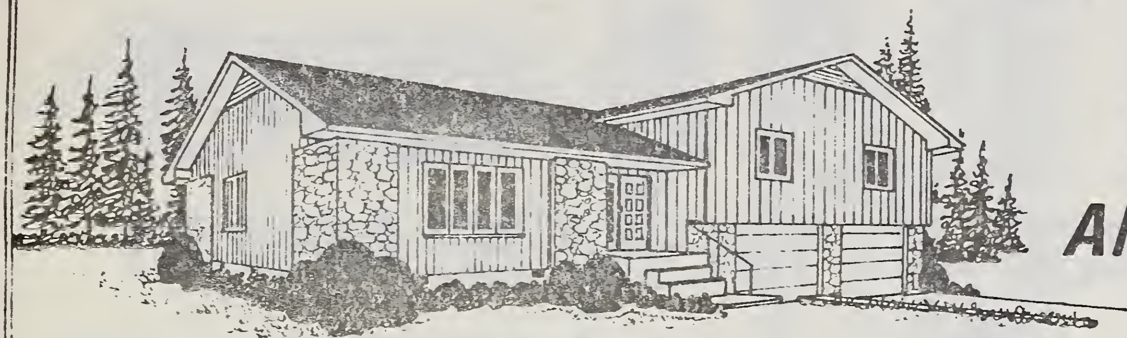
Additional rate reform measures have followed with seasonal-interruptable and time-of-day off peak rates. If a member agrees to let us cut off his service to certain loads during our daily "on-peak" hours for example, he will be credited with Verendrye's demand charges in the form of savings. This effort at conserving peak power has been very popular with those members participating.

As KW demand charges continue to rise, conservation and member relations will continue to play an important, vital part in the cooperative. An effective energy conservation program will not only reduce consumer consumption, but will reduce individual member demands. As a result this will provide some relief to power generation systems. The quicker new high cost power plants come into production, the quicker rates will continue to increase.

Conservation is an absolute necessity for good member relations at this point in time, they go hand in hand. High power costs and energy shortages in the future will be difficult for consumers to accept. A sincere system-wide energy conservation program will be essential to maintain member credibility in the future.

COOPERATIVE EXTENSION SERVICE

UNIVERSITY OF ARKANSAS Division of Agriculture, U.S. Department of Agriculture, and County Governments Cooperating



ENGINEERING AND YOUR HOME

FOAM INSULATION BOARD AND ENERGY HOUSES

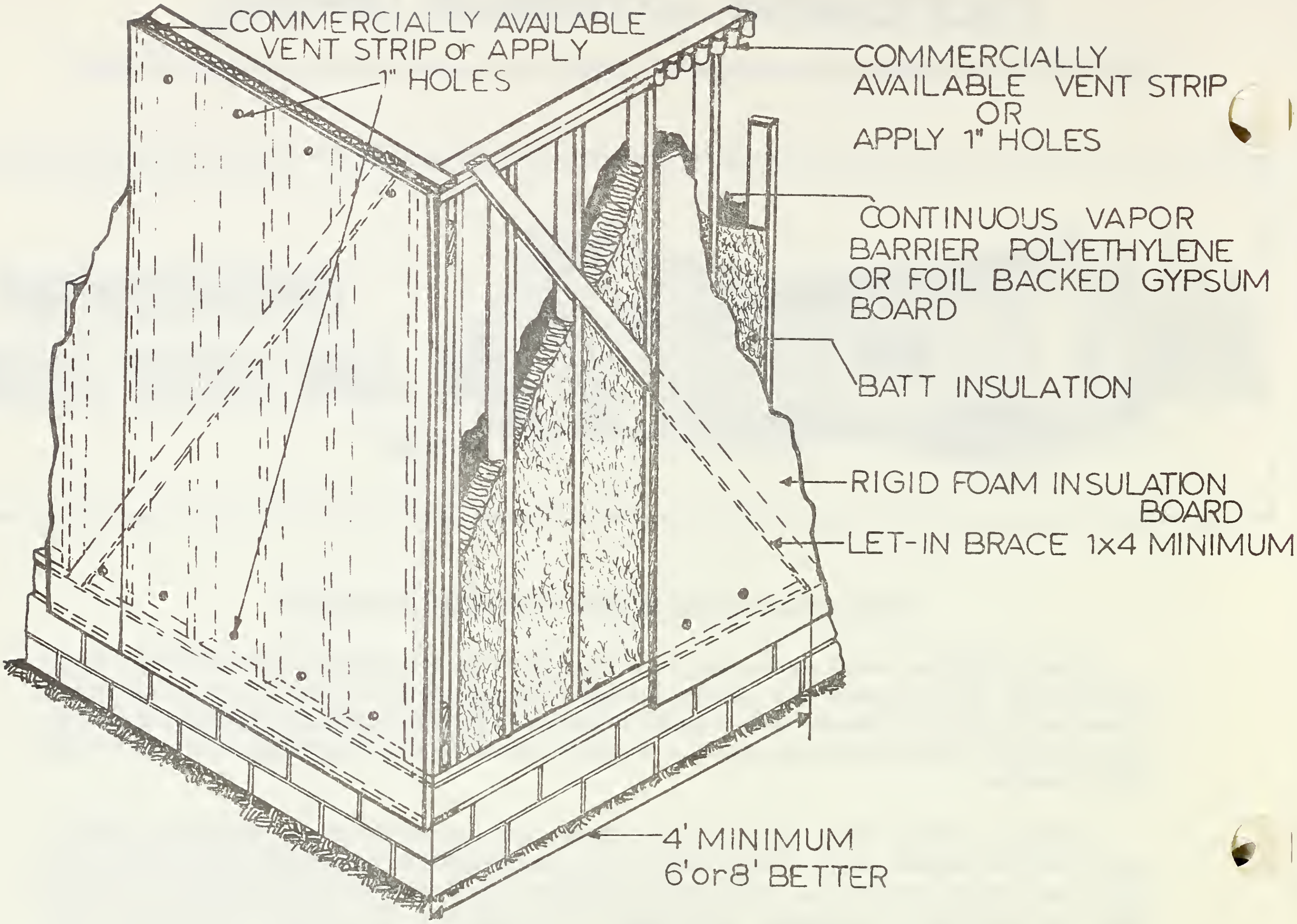
Foam insulation board can be used as wall sheathing in new homes to add insulation to the outside walls. This is presently a popular method of construction in some of the energy saving houses being built in Arkansas. Foam boards can be used effectively to reduce heat transfer through a wall. However, they must be installed so moisture cannot become trapped inside the wall during winter months.

During the winter, water vapor generated inside the home tries to move through the exterior walls from the warmer indoor temperatures to the cooler outdoor temperatures. Water vapor can easily pass through most interior wall finishing materials. If it is allowed to move freely into the wall cavity and through the insulation, condensation can result when the moisture reaches the cooler surfaces at the outside edge of the wall. Therefore, it is essential that a vapor barrier be used on the interior side of the wall to protect the insulation and wooden framing members from condensation. This barrier should be as complete and leakproof as possible.

Realistically, it is almost impossible to install a vapor barrier with no leaks around or through it. Even polyethylene film, an excellent vapor barrier material, will have leaks at electrical outlets and possibly around door and window openings. So it is a good precaution to assume that some water vapor will find its way into the wall during winter months, and it is very important that this moisture is allowed a path to escape on the exterior side of the wall.

Commonly used sheathing materials such as low density fiber-board will allow some water to pass through the material. But most foam materials are excellent vapor barriers that allow almost no passage of water vapor. Therefore, if foam insulating board is applied on the outside of a wall for sheathing, you should ventilate the wall cavity to allow an escape route for any moisture that may move into the wall. A carefully applied continuous vapor barrier, such as polyethylene film or foil backed gypsum board, should be installed to the interior side of the wall to keep water vapor out of the wall.

Installing foam board so it will "leak" a little air is not difficult. Some boards are applied in horizontal strips and have enough joints to allow for some water vapor passage. Other foam boards are applied in large sheets and will allow very little water vapor to escape. Ventilator strips are available from some foam insulation manufacturers, and can be installed at the top and bottom of a wall to allow for some ventilation behind the foam board. Or, a one-inch hole could be cut or drilled in the board at the top and bottom of each stud space so some air leakage could occur.



Arkansas generally experiences mild winters as compared to our northern neighbors. During a mild winter when sub-freezing temperatures are not present for extended periods of time, water vapor movement and condensation will not be much of a problem. However, when an extended period of cold weather develops such as we had this past winter, severe condensation problems can develop.

For example, over a period of years, Little Rock's average January temperature is 39.5°F., but during January, 1977, it was 31.3°F., and January, 1978, it was 31.7°F. The yearly average January temperature at Fayetteville is 37.6°F., but in January, 1977, it was 25.1°F., and January, 1978, it was 27.1°F. Temperatures this low for a month can result in condensation in a wall that has minor leaks in the inside vapor barrier. So when designing a new home, consider the worst conditions the home will be subjected to rather than the average.

When using foam boards as sheathing, remember that they are not strong enough to adequately brace a wall section. Therefore, plywood sheathing or "let-in" braces must be used in corners and other points as necessary to brace the wall. Let-in bracing is good to use with foam boards, because the foam boards can be applied over the braces to completely insulate the wall surface.

John Langston

John Langston
Extension Agricultural Engineer

JL:tf
A31-2-78

E&E 1-1

Cooperative Extension Service

UNIVERSITY OF ARKANSAS Division of Agriculture, U. S. Department of Agriculture and County Governments Cooperating

ENERGY $ MANAGEMENT ✓ CHECKLIST

Elizabeth Ellis
Extension Specialist - Household Equipment

This checklist is designed to help you see how effectively you are conserving energy and alert you to how you can improve your efficiency as a manager. Although some of the suggestions involve spending money, the long-range benefits achieved from the reduction in energy used will soon pay for the cost. Some suggestions will require both time and energy. Your knowledge and skills are resources, too. As energy supplies decrease and costs rise, you must weigh your use of resources with greater care.

NAME ______________________________

ADDRESS ______________________________

____

DATE CHECKED ______________________________

No.	Have Done	Will Check	Need Information	Will Consider	
					Temperature control
1					Reduce daytime home heating in winter, maintaining 65°F. (18°C.) or lower temperature.
2					Set window air-conditioning unit to recirculate cool air instead of pulling in warmer outside air.
3					Increase temperature setting for summer airconditioning to 78°F. (26°C.) or higher.
4					Reduce nighttime winter temperature 5°-8°F. (3°-5°C.) or more.
5					Use window and attic fans for cooling during summer when outside temperature is below temperature in home and when outdoor humidity is comfortable.
6					Maintain heating and cooling equipment in good operating condition.
7					Keep air filters clean to make it easier for heating and cooling system to do its job.
8					Close off unused rooms and closets.
9					Use kitchen and bathroom exhaust fans only when necessary.
10					Install an exhaust fan in the attic to remove hot air in the summer.
11					Shade windows from direct sun in summer with draperies and roll-up shades.
12					Open draperies and raise shades to receive sun's heat in winter.
13					Close door of attached garage in winter.
14					Close damper when fireplace is not in use.
15					Select an energy-efficient air-conditioning unit which is the proper size for space to be cooled. It is better to buy a slightly undersized unit, rather than an oversized one.
16					Repair leaks and insulate heating and cooling ducts in spaces not heated or cooled.
17					Adjust radiator valves, air duct dampers, or heat registers according to activity in area.
18					Reduce heating and cooling temperatures when away from home for long periods of time.
					Insulation reduces heat loss or heat gain, improves comfort, and reduces energy required for heating and cooling.
19					Ceiling — minimum R-Value of 19.
20					Walls — minimum R-Value of 11. (Adding insulation to the walls or an existing dwelling is expensive, and the return on your investment may take several years depending on your fuel costs. Proper vapor protection must be provided for the walls.)
21					Crawl space or unheated basement — minimum R-Value of 11.
					Window and door protection for winter.
22					Install storm windows and storm doors, or
23					Cover windows and doors with plastic.
					Protect home from cold winter wind.
24					Plant or build a windbreak landscape treatment.
25					Use garage entrance where possible.
26					Protect entrances with double-door arrangement.
					Seal air leaks.
27					Weather-strip doors, windows, and all movable joints.
28					Caulk interior and exterior cracks.
29					Seal unused doors.
30					Cap unused flues and (or) chimneys.

No.	Have Done	Will Check	Need Information	Will Consider	
					Protect home from summer sun.
31					Plant deciduous trees.
32					Use awnings or other treatment.
					Utilize breezes for cooling during warm season.
33					Close windows during midday.
34					Open windows in evening.
					Lighting
1					Turn off unnecessary lights, indoors and out.
2					Reduce lighting levels to minimum for task to be performed.
3					Use bulbs with lower wattage in halls, stairways, and other areas of general illumination.
4					Use light colors in decorating to improve lighting efficiency.
5					Do tasks that require a high light level during daylight hours when possible.
6					Keep lighting fixtures clean.
7					Use fluorescent lighting for maximum light from electrical energy used.
8					Use timers to turn lights on in the evening rather than leaving lights on all day when no one is home.
					Food preparation: oven and range
1					Use oven to capacity.
2					Use cooking utensils that fit surface unit.
3					Use tight-fitting lids on cooking utensils, when appropriate.
4					Reduce heat to maintain necessary cooking temperature when using surface units.
5					Use small appliances for cooking if they are more efficient than a range.
6					Preheat oven only for leavened foods. Do not preheat longer than needed to attain required temperature.
7					Turn off oven and surface units when food is cooked.

No.	Have Done	Will Check	Need Information	Will Consider	
					Food preservation: refrigerator, freezer
8					Avoid opening door or holding it open unnecessarily.
9					Keep grilles and evaporator coils clean.
10					Locate cooling appliances away from heat sources such as range, hot air register, or direct sunlight.
11					Defrost as needed.
12					If cold air is leaking around door, have door adjusted or gasket replaced.
13					Empty, clean, turn off, and leave refrigerator door open when taking an extended vacation.
					Dishwashing
1					Accumulate dishes; hold until dishwasher is full. If dishes are hand washed, rinse and hold breakfast and lunch dishes until evening.
2					Do not let hot water run continuously while washing or rinsing dishes.
3					Omit dishwasher drying cycle; open the door at end of the rinse cycle.
					Heating water
1					Reduce amount of hot water used.
2					Insulate long hot water pipes, especially those under the house or those that go through unheated basements or crawl spaces.
3					Repair leaky faucets.
4					Maintain regular temperature setting of 110°-120°F. (43°-49°C.) on water heater if automatic dishwasher is not used, 140°F. (60°C.) if automatic dishwasher is used. (Reducing the thermostat setting may only be feasible for residences with only one or two occupants, because number of occupants will affect the amount of hot water available.)
					Laundry
1					Wash only full loads of laundry.
2					Use heated water in only the wash cycle.

Have Done | Will Check | Need Information | Will Consider

3 Use water no hotter than necessary for adequate soil removal and sanitation.

4 Use good laundry techniques to obtain satisfactory results in one washing process.

5 Avoid overdrying in clothes dryer.

6 Sort dryer loads by weight.

7 Line-dry garments and household items when practical.

8 Use dryer efficiently. Avoid drying one or two items at one time.

9 Remove items when dryer stops to avoid unnecessary wrinkling, which will require ironing to remove.

10 Reduce ironing to a minimum by careful selection of garments and household linens.

Cleaning and maintenance

1 Empty or replace vacuum cleaner bag frequently to keep it functioning efficiently.

2 Use hand equipment rather than power tools when practical.

3 Develop preventive maintenance practices. Routine checkup and servicing will prevent greater problems later.

Personal care

1 Minimize hot water used in bathing. Check to see if less water is used in showering than in tub bathing.

2 Do not leave water running while shaving or brushing teeth.

Have Done | Will Check | Need Information | Will Consider

Recreation and Entertainment

1 Turn off home entertainment equipment when no one is really watching or listening.

2 Disconnect or use vacation setting on an instant-on television when you are not going to be using it regularly.

3 Maintain tools in good operating condition.

4 Encourage family members to develop leisure activities that have low energy costs such as bicycling, hiking, reading, and swimming.

5 Spend vacations closer to home.

6 Encourage home and neighborhood activities.

Family transportation

1 Drive at a moderate speed.

2 Drive smoothly with gradual starts and stops.

3 Drive slowly for first mile instead of letting car warm up by idling.

4 Provide proper maintenance; make sure you have well-tuned engine and properly inflated tires.

5 Combine errands by careful planning.

6 Carpool whenever possible.

7 Walk, ride a bicycle, or use public transportation whenever possible.

SOURCE: Cooperative Extension Service, Cornell University, Ithaca, New York.

EE:tdm
HE201-8-77

INTERMOUNTAIN RURAL ELECTRIC ASSOCIATION

November 1, 1978

I am enclosing the energy audit form which we use here at Intermountain REA. We utilize the specific data collected in the worksheets in formulating cost-effective investment recommendations. The homeowner receives the white copies of the final three sheets. The energy advisor explains how the figures were arrived at upon completion of the audit and we retain the worksheets and a copy of the recommendations.

We've done about 100 audits since August. When the sample reaches a sufficient size, we feel it will offer a good data base from which to project new residential loads.

A few notes of explanation:

- Since degree days in our service area vary from 5480.4 to 10325.2, we've divided our service area into 12 climatological districts which correspond to an equal number of U.S. Weather Bureau reporting stations.

- Home sketches (including orientation to sun and wind) anticipate potential active and passive solar retrofit.

- Under "Heat Loss by Infiltration," only those areas which have potential for change are addressed.

- "R" values of 1 and 2 are used for single and double glazed windows respectively. More accurate "R" values are considered only if the homeowner is considering investing in new or additional glazing.

- Wall insulation is checked via electrical cover plates. Spot radiometers (thermographic sensors) will be utilized to check areas missed by insulators.

- In computing paybacks on investments, local contractors are surveyed and costs are figured on average installed cost per square foot, per "R" value; per united inches of glazing etc.

- Worksheet page #6 (Heating System, Appliances etc.) concerns direct home energy management, load controllers, etc. It helps to assess the applicability of our residential demand and energy rate.

HOME ENERGY AUDIT WORKSHEETS

Intermountain Rural Electric Assn.
Phone: 303-794-1535

2100 W. Littleton Blvd.
Littleton, Colorado 80160

Homeowner's Name ______________________ Date ____________

Address ______________________ Time ____________

______________________ Phone ____________

____

Location ______________________

Special Directions ______________________

____

____

____

Builder ______________________

____

Degree Days ____________ Style of House ____________ Age of House ______

Comments ______________________

____

____

____

____

____

Assistance Given ______________________

____

____

____

Further Assistance ______________________

____

____

____

Account Number ______________________ Billing Records (from/to) ______/______

Referred By ______________________

Advisors Name ______________________

—sketch all views, dimensions; include heights and perimeter lengths in feet

—label all windows and doors: (1) single glazed, standard door
(2) double glazed, insulated door, standard door with storm door
(3) triple glazing, insulated door with storm door

Front View	Right Side View

Left Side View	Rear View

Plan View
Direction

Heating units— □ (central furnace, boiler, heat pump)
baseboard unit ▭

Hot Water Heater- ○

Fireplaces = △

HEAT LOSS BY INFILTRATION

Building Component	.5 air change per hour	1.0 air change per hour	1.5 air change per hour	2 or more air changes per hour
basement or crawl space	• tight, no cracks • caulked soleplate • sealed basement windows □ • caulked soleplate • plywood floor • no leaks around water, sewer, electrical openings and trap door • vents closed in winter	• Soleplate needs more caulking • loose basement windows □ • soleplate needs caulk • tongue/groove board floor • some leaks around trap door and pipe openings	• some foundation cracks • loose basement windows □ • no caulk around soleplate • board floor • leaks around door and pipe openings	• major cracks in foundation • little or no caulking □ • strong air movement and leaks
walls	• poly plastic film under wallboard • building paper under siding • electrical boxes caulked and with rubber gaskets □ • well insulated walls	• no plastic film • building needs paint □	• no building paper used □	• cracks and openings in walls □
windows and doors	• well caulked windows and window frames □ • weatherstripped, tight fitting doors	• partially caulked windows and frames □ • some weatherstripping needed	• little or no caulking around window frames □ • loose fitting doors	• large cracks around windows and doors □
other	• furrdown ducts • vestibule entrance • no recessed lights □ • glass screen in fireplace • charcoal filtering in kitchen and bath	• attic ducts • no vestibule • recessed lights □ • no glass screen • outside venting	• attic ducts not taped or insulated • windward door used often □	

Draft Index = (# check marks) × (air change per hr.) ÷ 4

☐	×	☐	+	☐	=	☐	× .018 ×	☐	×	☐	×	☐	=	☐
floor area (ft²)		wall height around conditioning space (ft)		vaulted ceiling/other air volume (ft³)		volume of conditioned air in building (ft³)		draft index		degree days per year		experience factor		heat loss by infiltration (BTU's per yr.)

INTERIOR Ventilation: bath ________ (inside or outside) range ________ dryer ________ EXTERIOR Ventilation: roof# ________ type ________ size ________	FIREPLACES number ________ damper ________ heat circulator ________ glass screen ________ outside air source ________ other ________ ________	WOOD STOVE type ________ efficiency ________ heating capacity ________ other ________ DUCTS location (basement or attic) ________ taped ______ insulated ______ inside/outside thermal envelope

HEAT LOSS BY CONDUCTION THROUGH WINDOWS AND DOORS

Double Glazed Windows, insulated doors, Standard Doors with Storm Doors

width (in) ×	height (in) ×	number =	area (in²)
		total area (in²)	

______ Total area (in²) ÷ 144 = ______ Total area (ft²) ÷ ______ "R" value

× ______ degree days per year × ______ experience factor = ______ heat loss by conduction (BTU's per year)

Single Glazed Windows, Standard Doors without Storm Doors

width (in) ×	height (in) ×	number =	area (in²)
		total area (in²)	

______ total area (in²) ÷ 144 = ______ total area (ft²) ÷ ______ "R" value

× ______ degree days per year × ______ experience factor = ______ heat loss by conduction (BTU's per year)

HEAT LOSS BY CONDUCTION THROUGH WALLS

material	Thickness (in)	"R" value
interior surface		0.68
outside surface		0.17
	Total "R" value	

______ total perimeter of outside wall (ft) × ______ total height of outside wall (ft) + ______ additional area (ft²)

= ______ gross wall area (ft²) - ______ total window and door area (ft²) = ______ net wall area (ft²) ÷ ______ total "R" value

× ______ degree days per year × ______ experience factor = ______ heat loss by conduction (BTU's per year)

basement walls: percent above ground ______

basement: percent of floor plan ______

percent heated ______

HEAT LOSS BY CONDUCTION THROUGH FLOORS

floor exposure factors	
building on post/pillars; no skirting below floor	1.0
crawl space skirted	.8
rock wall basement	.8
more than 2 foot of basement wall exposed above grade	.8
building with tight crawl space	.5
building with tight basement (un-heated)	.5

material	thickness (in)	"R" value
interior surface		0.68
interior surface		0.68
	total "R" value	

[ ] × [ ] ÷ [ ] × [ ] × [ ] = [ ]

floor area (ft^2) × floor exposure factor ÷ total "R" value × degree days per year × experience factor = heat loss by conduction (BTU's per year)

EXCEPTIONS

	floor perimeter (ft)	5/3 'R"	D.D./yr.	E.F.	heat loss by conduction (BTU's/yr.)
(a) Slab on grade	[ ] ×	[ ] ×	[ ] ×	[ ] =	[ ]
(b) heated basement floor	floor area (ft^2)	2	210	E.F.	heat loss by conduction (BTU's/yr.)

- crawl space: average height ______
  venting ______
- slab insulated ______
- foundation insulated ______

HEAT LOSS BY CONDUCTION THROUGH CEILINGS

material	thickness (in)	"R" value
interior surface		0.68
interior surface exterior		0.68 0.17

EXCEPTIONS:
use formula below

$$U = \frac{Ur\ Mc}{Ur + Uc/M}$$

(1) uninsulated ceiling
(2) part cathedral, part attic
(3) non-vented roof

$R = 1/U$

where: Ur = transmittance of roof
Uc = transmittance of ceiling
M = area of roof ÷ area of ceiling

[ ] ÷ [ ] × [ ] × [ ] = [ ]

ceiling area (ft^2) ÷ total "R" value × degree days per year × experience factor = heat loss by conduction (BTU's/yr)

TOTAL HEAT LOSS PER YEAR

Type of Heat Loss	Heating Units Required	
Infiltration	from page 3	
Conduction, double glazing	pg. 4	
Conduction, single glazing	pg. 4	
Conduction, walls	pg. 4	
Conduction, floors	pg. 5	
Conduction, ceilings	pg. 5	
	total heat loss (BTU/yr)	

[ ] ÷ 3415 = [ ] KWH/yr

BTU's/yr

HEATING SYSTEM

Type of Fuel:
(P) Primary
(S) Secondary

_____ Electricity
_____ Natural Gas
_____ Propane

_____ Fuel Oil
_____ Coal/Coke
_____ Wood

_____ Solar
_____ Other (specify below)
____

Type of Heating System	Primary (P) Secondary (S)	Zones or Rooms	KW Rating	Thermostat Setting	Other

APPLIANCES (including wattage)

_____ Range (12,200)
_____ Oven-self clean (4,000)
_____ Oven-standard (3,200)
_____ Broiler (3,600)
_____ Large Surface Unit (2,400)
_____ Small Surface Unit (1,300)

_____ Microwave Oven (1,500)
_____ Portable Broiler (1,500)
_____ Deep Fat Fryer (1,448)
_____ Roaster (1,333)
_____ Hot Plate (1,250)
_____ Griddle/Grill (1,161)

_____ Electric Fry Pan (1,196)
_____ Dishwasher (1,200)
_____ Hand Iron (1,008)
_____ Clothes Dryer (4,850)

HOT WATER HEATING

Capacity __________
Fuel _____ Watts _____

Temperature Setting: upper _____
Temperature Setting: lower _____

Pipes: insulated __________
in heated space __________

MISCELLANEOUS

number of occupants _____
number of rooms _____
remarks ____
occupant comments ____
number of rooms heated ____

LOAD CONTROL

____
____
____

HOME ENERGY AUDIT
RECOMMENDED INVESTMENTS

Intermountain Rural Electric Assn.
Phone: 303-794-1535

2100 W. Littleton Blvd.
Littleton, Colorado 80160

Homeowner Name ______________________________ Date ______________

Account Number ____________ Advisor's Name ________________ Ph. # ____________

The following recommendations are based on an analysis of the variables affecting heat loss in your home. Using accepted industry measures, this audit attempts to project as accurately as possible, the savings to be achieved with various weatherization investments. However, since such variables as lifestyle and weather are not controllable, no guarantee of reductions in electric bill is made.

WEATHERIZATION INVESTMENTS

Heat Loss Infiltration occurs when the air you pay to heat in your home escapes and is replaced by the cold outside air which must then be heated. These leaks occur through cracks, many of which are not readily visible. Wind can cause a buildup of pressure on a portion of the house, forcing air through even the smallest cracks. Caulking and weatherstripping are used in many areas to address this problem since nearly all building materials expand and contract with changes in weather.

IN YOUR HOME YOU SHOULD ADDRESS THE FOLLOWING:

Basement or Crawl Space	Windows and Doors
☐ caulk between foundation and sill plate	☐ caulk perimeter cracks
☐ repair foundation cracks	☐ weatherstrip as needed
☐ caulk around basement windows	☐ ______________
☐ ______________	☐ ______________

Walls	Other
☐ caulk around electrical plates	☐ tape/insulate ducts
☐ install gaskets in cover plates	☐ kitchen/bath fans ______________
☐ ______________	☐ fireplace ______________
	☐ ______________
	☐ ______________
	☐ ______________

Estimated cost of the above investment is [ ]

Upon completion of the above improvements, projected savings would be:

[ ] B.T.U./year or [ ] K.W.H./year

The estimated payback on investment would be [ ] years

Heat loss by conduction occurs when heat is transferred directly from one part of an object to another part (as when the handle of a cast iron frying pan eventually gets hot). If one surface of the material is heated, (i.e. the inside floors, walls and ceilings) the heat will be conducted through the material to the colder (outside) surface. Some materials, of course, will conduct better than others. Insulation is a poor conductor, thus it is used in homes to considerably slow the escape of heat. When insulation is not possible (i.e. windows and skylights), extra glazing is used to slow the escaping heat.

IN YOUR HOME YOU SHOULD ADDRESS THE FOLLOWING:

WINDOWS	DOORS
☐ add storm windows	☐ add storm doors
☐ retrofit with double glazing	☐ retrofit with insulated door
☐ ______________________	☐ ______________________
☐ ______________________	☐ ______________________

Estimated cost of the above investment is [ ]

Upon completion of the above improvements, projected savings would be:

[ ] B.T.U./year or [ ] K.W.H./year

The estimated payback on investment would be [ ] years

EXTERIOR WALLS

☐ add R [ ] of [ ] insulation to give your exterior wall a total insulation value of R [ ]

☐ add a [ ] vapor barrier on the heated side ______________________

☐ ______________________

☐ ______________________

Estimated cost of the above investment is [ ]

Upon completion of the above improvements, projected savings would be:

[ ] B.T.U./year [ ] K.W.H./year

The estimated payback on investment would be [ ] years

FLOORS

☐ add R ____ of ____ insulation to give your ____ floor a total insulating value of R ____.

☐ add a ____ vapor barrier on the heated side ____

☐ ____

Estimated cost of the above investment is ____

Upon completion of the above improvements, projected savings would be:

____ B.T.U./year ____ K.W.H./year

The estimated payback on investment would be ____ years

CEILINGS

☐ add R ____ of ____ insulation to give your ceiling a total insulating value of R ____.

☐ add a ____ vapor barrier on the heated side ____

☐ ____

Estimated cost of the above investment is ____

Upon completion of the above improvements, projected savings would be:

____ B.T.U./year or ____ K.W.H./year

The estimated payback on investment would be ____ years

OTHER INVESTMENTS

A. ☐ ____

B. ☐ ____

C. ☐ ____

D. ☐ ____

Estimated cost of the above investment is ____

Upon completion of the above improvements, projected savings would be:

____ B.T.U./year or ____ K.H.W./year

Estimated payback on investments ____ would be ____ years.

TVA 6254A (PU-3-78)

Budget Bureau Approval No. 74R0[illegible]
Expiration Date July 1982

HOME INSULATION PROGRAM
HOME ENERGY SURVEY

Form No. [—]

Name ______________________ Date ______________

Address ______________________ Phone ______________

| 1 | | Distributor ______________________ Account Number ______________

| 2 | | Type of Customer
(1) Customer Homeowner (2) Customer Tenant
(3) Customer Landlord (4) Noncustomer Landlord

| 3 | | Type of Home
(1) One story (2) Two story
(3) Split-level (4) Mobile Home
(5) Other ______________

| 4 | | Primary Energy Used for Heating
(1) Electric (2) Gas (3) Oil
(4) Other ______________

| 5 | | Type of Heating System
(1) Heat pump (2) Central furnace
(3) Floor furnace (4) Room heaters

| 6 | | Type of Cooling System
(1) Electric central
(2) Electric window
(3) Other ______________
(4) None

EXISTING ATTIC INSULATION

7				Square Footage-Heated A[illegible]
8				Approx. R-Value
*				Depth (inches)
*				Type

(1) Fiberglass Batts (2) Fiberglass loose-fill (3) Rockwool Batts
(4) Rockwool loose-fill (5) Cellulose
(6) Other ______________

ADDITIONAL ATTIC INSULATION RECOMMENDED

9				R-Value to be Added
10				Cost/Square Foot
11				Estimated Total Cost

EXISTING ATTIC VENTILATION

| 12 | | Square Feet Net Free Area

ADDITIONAL ATTIC VENTILATION RECOMMENDED

13		Square Feet Net Free Area
14		Estimated Total Cost

COMMENTS: ______________________

| 15 | | Approx. age of residence (years)

| 16 | | Do you plan to insulate your attic?
(1) With loan (2) Without loan (3) Do not plan to insulate

If you have an existing electrically heated or cooled home, you may be eligible for an interest-free loan through your power distributor home insulation program to cover the cost of adding attic insulation and natural ventilation. To cover the cost of the energy conservatio[n] improvements below, you must make other financial arrangements. The costs shown on this Survey are local average costs for labor an[d] materials.

| 17 | | Type of Floor
(1) Basement (2) Crawl space (3) Slab

18		Accessible Under Floor Area (Sq. Ft.)
19		Existing R-Level
20		Add (R-Value)
21		Cost/Ft.^{2}
22		Estimated Total Cost
23		Ground Cover Needed (1) Yes (2) No
24		Additional Ventilation Needed (1) Yes (2) No
25		Wall Insulation (1) Yes (2) No
26		Number of Water Heaters
27		(1) Electric (2) Other
28		Number to be Insulated
29		Cost per Water Heater
30		Estimated Total Cost
31		Number of Storm Windows Required
32		Total Square Footage
33		Estimated Total Cost

Duct System: ______________________

*		Doors Requiring Weatherstripping
*		Number of Thresholds
*		Windows Requiring Caulking
*		Doors Requiring Caulking

COMMENTS: ______________________

If you do not plan to take all of these energy conservation measures at this time, we recommend that you take them in the following order

1st ______________ 2nd ______________ 3rd ______________ 4th ______________

By ______________________ Organization ______________________
(TVA or Power Distributor)

IMPORTANT NOTICE: These recommendations are provided to you as a free service of TVA and your power distributor and represent the opinion of the Energy Advisor conducting the Survey. There is NO GUARANTEE or WARRANTY, expressed or implied, as to the effectiveness of any of these recommendations or as to their cost if you choose to install them.

KNOXVILLE UTILITIES BOARD

626 Gay Street, S.W.

CONSERVATION CREW ENERGY ANALYSIS

Name ________________________________ Account Number ____________

Address ________________________________ Date ____________

COST OF OPERATION CHART

NOTE: These are **average energy uses** for a family of four.

Appliance	Average Wattage	Average kwh Monthly use	Hint	Estimated kwh Per Month	Average cu. ft. Natural Gas	Estimate ft. per m
REFRIGERATOR			Does your customer have more			
12'-16' standard	265	120	than one refrigerator?	______		
16' frostless	475	236		______		
20' frostless	540	276	Add or subtract 20 kwh per cu. ft.	______		
FREEZER						
12'-15' standard	350	190		______		
12'-15' frostless	440	240		______		
TELEVISION						
Color	332	108	How many TV's?	______		
Black & White	237	66	Is TV viewed more than 4 hrs. daily?	______		
RANGE	12,000	150	Add 25 kwh or 125 cu. ft. for each additional family member	______	695	______
WATER HEATER (quick recovery)	4,500	160 per person × ______	Is this a generous user? How many baths per day? Showers?	______	742 per person × ______	______
CLOTHES WASHER	600	.5 per load × ______	No. loads per month	______		
CLOTHES DRYER	4,350	5 per load × ______	No. loads per month	______	23 per load × ______	______ No. loa per mor
DISHWASHER	1,190	48		______		
MISCELLANEOUS (Small Appliances)		25	Any gourmet cooks in family? Teenagers?	______	600-5500	______
WATER PUMP	460	120		______		
LIGHTING		75-150		______		

ESTIMATED BASE LOAD KWH AND/OR CU. FT. PER MONTH ESTABLISHED FROM INFORMATION SUPPLIED BY CONSUMER TOTAL ______ ______

Does not include heating or cooling.

Cost may be estimated by multiplying number of kilowatt hours by cost of a kwh.

______ kwh × ______ cost of one kwh = $______ estimated cost of base load

______ cu. ft. of nat. gas × ______ cost of one cu. ft. = $______ est. cost base load nat. gas

CONSERVATION CREW ANALYSIS

Type of Construction: ________________________ Square Feet? ____________

Type of heating: ____________ Fuel ______ Type of cooling: ______ Central ______ Window ______

Here is a 15-point list to use in checking your home for wasted energy. The more YES answers, the less energy wasted.

YES	NO	
____	____	Attic has minimum R factor of 19.
____	____	Floor has minimum R factor of 11.
____	____	All window and door frames and frames for room air conditioners are caulked and sealed tightly.
____	____	Exterior doors, doors leading to unheated areas and all windows are weatherstripped and/or tightly sealed.
____	____	Supply and return air ducts in unheated areas are insulated.
____	____	Attic and crawl space vents are kept open for ventilation.
____	____	Thermostat for winter heating set at 68°F.
____	____	Thermostat for summer cooling set at 78°F.

YES	NO	
____	____	Thermostat is set back at night or when away from h for eight hours or longer. (Exception-Heat pump and ce cable).
____	____	Unnecessary lights and appliances are turned off.
____	____	There are no water leaks.
____	____	Heating and/or cooling filters are cleaned regularly.
____	____	Fireplace damper is closed when not in use. (The best to use the fireplace is when the main heating syste turned off.)
____	____	There are storm windows and doors throughout the h

RECOMMENDATIONS: ________________________________

____

____

Conservation Consultant — 524-2911, Ext. ______

TENNESSEE VALLEY AUTHORITY

MANUAL OF HOME WEATHERIZING

MANUAL OF HOME WEATHERIZING

CONTENTS

THE BASICS OF HEAT FLOW

The objective of this brochure is to permit the calculation of insulation performance and energy savings. As a first step, the basics of heat flow control merit review.

HOW HEAT FLOWS

Heat is energy. It always moves in just one direction, from warm to cold. And the greater the temperature difference, the greater the flow of heat. Cold is merely the absence of heat.

Heat always flows in one of three ways:

CONDUCTION - Conduction is heat passing through solids or between solids in contact with one another. Heat travels from your hand to a cold glass or from a hot cup to your hand. Conduction is the major route for travel of heat through a building material. Heat flow is from molecule to molecule; so in general, the more dense a material is, the faster the heat will flow by conduction. For example, in glass or metals or concrete, the molecules are close together and the heat flow is rapid while in air or wood, the molecules are farther apart and the heat flow is much slower.

CONVECTION - Convection is heat moving from solids by air movement. As air comes in contact with a warmer surface, it receives heat which causes it to expand and become lighter so that it rises. As it comes in contact with a colder surface , it gives up heat which causes it to contract and become heavier so that it falls.

RADIATION - Heat flow by radiation occurs as heat in a wave form moves from a warm object to a cold one across an air space without heating the air. We feel uncomfortable next to a cold wall because our bodies lose heat by radiation.

DEFINITIONS

The symbols and terms defined below are the principal ones involved in heat flow:

BRITISH THERMAL UNIT (Btu): Defined as the amount of heat needed to raise the temperature of one pound of water $1^{o}F$. at sea level. The Btu is used to measure the amount of heat just as the inch or foot is used to measure length or as the minute or hour is used to measure time. For example: there are approximately 13,000 Btu's in a pound of coal; 141,000 Btu's in a gallon of oil; and 1,000 Btu's in a cubic foot of natural gas.

BTU PER HOUR (Btuh): The measure of heat flow. It represents the number of Btu's which will travel through a given building material or section in one hour.

WATT: Another measure of heat flow used in electric heating. One watt equals 3.413 Btuh.

KILOWATT (kW): 1,000 watts.

KILOWATT HOUR (kWh): 1,000 watts operating for one hour.

k,-THERMAL CONDUCTIVITY: The amount of heat that passes through a homogenous material 1 inch thick and 1 square foot in area, in an hour's time, with a temperature difference of 1°F. between the two surfaces. Values of k are expressed in Btu's per hour (Btuh). The lower the k, the higher the insulating value.

C,-THERMAL CONDUCTANCE: Similar to conductivity but a measure of the rate of heat flow (Btu's) for the actual thickness of a material (either more or less than 1 inch) 1 square foot in area at a temperature difference of 1°F. The term usually is applied to homogenous materials, though it may be used with heterogeneous ones such as concrete block. If the k of a homogenous material is known, the C can be determined by dividing the k by the thickness. For example, a 3-inch thickness of a particular insulation with a "k" of 0.30, has a "C" of 0.10. The lower the "C," the higher the insulating value.

U,-OVERALL COEFFICIENT OF HEAT TRANSMISSION: The combined thermal value of all of the materials in a building section, air spaces, and surface air films. U is expressed in Btuh per square foot of area per °F. temperature difference. The lower the U, the higher the insulating value.

R,-THERMAL RESISTANCE: A measure of ability to retard heat flow rather than ability to transmit heat. R is the numerical reciprocal of U, or C, thus $R = \frac{1}{U}$ or $\frac{1}{C}$. A wall with a U value of 0.07 has 14.3 units of resistance ($R = \frac{1}{U} = \frac{1}{0.07} = 14.3$). In this Manual, thermal

resistance, R, is used in combination with numerals to designate thermal resistance values: R-11 equals 11 resistance units. The higher the R, the higher the insulating value. All insulation products having the same R, regardless of material and thickness, are equal in insulating value.

DESIGN TEMPERATURES. The exterior and interior temperatures selected as the basis for design.

"TD" (DESIGN TEMPERATURE DIFFERENCE). Difference between the interior and exterior design temperatures of a building.

DD-(DEGREE DAY): A degree day is a measure of heating requirements. Degree days are determined by subtracting a day's average temperature from a base of 65 degrees. If the average temperature for a day was 55 degrees, that day would have a degree day rating of 10.

RESISTANCE VALUES OF STRUCTURAL AND FINISH MATERIALS, INSULATIONS, AIR SPACES, AND SURFACE FILMS*

Wood bevel siding, 1/2 x 8, lapped	R-0.81
Wood siding shingles, 16", 7½" exposure	R-0.87
Asbestos-cement shingles	R-0.03
Stucco, per inch	R-0.20
Building paper	R-0.06
1/2" nail-base insulating board sheathing	R-1.14
1/2" insulating board sheathing, regular density	R-1.32
25/32" insulating board sheathing, regular density	R-2.04
1/4" plywood	R-0.31
3/8" plywood	R-0.47
1/2" plywood	R-0.62
5/8" plywood	R-0.78
1/4" hardboard	R-0.18
Softwood, per inch	R-1.25
Softwood board, 3/4" thick	R-0.94
Particle board (underlayment) 5/8"	R-0.84
Concrete blocks, two rectangular cores	
Sand and gravel aggregate, 8" thick	R-1.04
Cores filled with vermiculite	R-1.93
Lightweight aggregate, 8" thick	R-2.18
Common brick, per inch	R-0.20
Face brick, per inch	R-0.11
Sand-and-gravel concrete, per inch	R-0.08
Sand-and-gravel concrete, 8" thick	R-0.64
1/2" gypsumboard	R-0.45
5/8" gypsumboard	R-0.56
1/2" lightweight aggregate gypsum plaster	R-0.32
25/32" hardwood finish flooring	R-0.68
Asphalt, linoleum, vinyl, or rubber floor tile	R-0.05
Carpet and fibrous pad	R-2.08
Carpet and foam rubber pad	R-1.23
Asphalt roof shingles	R-0.44
Wood roof shingles	R-0.94
3/8" built-up roof	R-0.33
Air spaces (3/4")	
Heat flow UP	
Non-reflective	R-0.87
Reflective, one surface	R-2.23
Heat flow DOWN	
Non-reflective	R-1.02
Reflective, one surface	R-3.55
Heat flow HORIZONTAL	
Non-reflective (also same for 4" thickness)	R-1.01
Reflective, one surface	R-3.48

Note: The addition of a second reflective surface facing the first reflective surface increases thermal resistance values of an air space only 4 to 7 percent.

Surface air films	
INSIDE (still air)	
Heat flow UP (through horizontal surface)	
Non-reflective	R-0.61
Reflective	R-1.32
Heat flow DOWN (through horizontal surface)	
Non-reflective	R-0.92
Reflective	R-4.55
Heat flow HORIZONTAL (through vertical surface)	
Non-reflective	R-0.68
OUTSIDE	
Heat flow any direction, surface any position	
15 mph wind (winter)	R-0.17
7.5 mph wind (summer)	R-0.25

Glass	
Single glass (winter)	U=1.13
Single glass (summer)	U=1.06
Insulating glass (double)	
1/4" air space (winter)	U=0.65
1/4" air space (summer)	U=0.61
1/2" air space (winter)	U=0.58
1/2" air space (summer)	U=0.56
Storm windows	
1" to 4" air space (winter)	U=0.56
1" to 4" air space (summer)	U=0.54

*Additional resistance values can be obtained from ASHRAE Handbook of Fundamentals published by the American Society of Heating, Refrigerating and Air-Conditioning Engineers.

Example calculations
(to determine the U value of an exterior wall)

Wall Construction	Uninsulated Wall Resistance	Insulated Wall Resistance
Outside surface(film), 15 mph wind	0.17	0.17
Wood bevel siding, lapped	0.81	0.81
1/2" insulating board sheathing, regular density	1.32	1.32
3½" air space	1.01	
R-11 insulation		11.00
1/2" gypsumboard	0.45	0.45
Inside surface (film)	0.68	0.68
Totals	4.44	14.43

For uninsulated wall, $U = \frac{1}{R} = \frac{1}{4.44} = U = 0.22$

Therefore, heat loss for the above uninsulated wall section at a +10°F. outside design temperature is equal to 0.22 x 60 (or 70-10) equals 13.2 Btuh per square foot of wall section. To convert to watts loss: 13.2 Btuh ÷ 3.413 = 3.87 watts loss per square foot per hour.

For insulated wall, $U = \frac{1}{R} = \frac{1}{14.43} = U = 0.07$

Therefore, heat loss for the above insulated wall section at a + 10°F. outside design temperature is equal to 0.07 x 60 (or 70-10) equals 4.2 Btuh per square foot of wall section. To convert to watts loss: 4.2 Btuh ÷ 3.413 = 1.23 watts loss per square foot per hour.

"R" VALUE

The ability of insulation to slow the transfer of heat is not only determined by its thickness but also by its density, weight, and other factors. The effectiveness of insulation is measured in Resistance or "R" value. This R-value is marked on all insulation you buy, whether it is in batt, blanket, rigid board, or loose-fill form. In the case of loose-fill insulation, the label on the container will show the minimum thickness necessary and the maximum number of square feet the contents of the container will cover to give the desired R-value.

Higher R-values may be justified as the cost of energy increases. However, here are the presently recommended minimum "R" values for homes in the TVA area:

Ceilings	R-19
Outside walls	R-11
Floors	R-11

TYPE OF INSULATION

	Batts or Blankets		Loose Fill (Poured-In)			
	glass fiber	rock wool	glass fiber	rock wool	cellulosic fiber	
R-11	3½" -4"	3"	5"	4"	3"	R-11
R-19	6" -6½"	5½"	8" -9"	6" -7"	5"	R-19
R-22	6½"	6"	10"	7" -8"	6"	R-22
R-30	9½" -10½"	9"	13" -14"	10" -11"	8"	R-30
R-38	12" -13"	10½"	17" -18"	13" -14"	10" -11"	R-38

Description	Conductivity (k)	Conductance (C)	Resistance (R) Per inch thickness (1/k)	Resistance (R) For thickness listed (1/C)
(MATERIAL--BOARD AND SLABS)				
Glass fiber, organic bonded ...	0.25	--	4.00	--
Expanded rubber (rigid)	0.22	--	4.55	--
Expanded polystyrene extruded, plain	0.25	--	4.00	--
Expanded polystyrene extruded, R-12 exp.)	0.20	--	5.00	--
Expanded polystyrene extruded, (R-12 exp.) (Thickness 1" and greater)	0.19	--	5.26	--
Expanded polystyrene, molded beads	0.28	--	3.57	--
Expanded polyurethane (R-11 exp.) (Thickness 1" or greater)	0.16	--	6.25	--
Insulating roof deck				
Approximately ....1½"	--	0.24	--	4.17
Approximately .... 2"	--	0.18	--	5.56
Approximately .... 3"	--	0.12	--	8.33
Wood shredded (cemented in preformed slabs)	0.60	--	1.67	--
Wood or cane fiberboard				
Acoustical tile .... ½"	--	0.80	--	1.25
Acoustical tile .... 3/4"	--	0.53	--	1.89
Urea formaldehyde foam	0.23	--	4.35	--

STUDY OF VARIOUS INSULATION MATERIALS

BATTS: Insulation batts are normally available in a glass fiber material and rock wool material either with or without a vapor barrier backing. The vapor barrier is usually also the stapling flange of the batt. If a vapor barrier is not a part of the batt, and a vapor barrier is needed, a polyethylene covering can be used with the batt. Batts are used to insulate attic floors, attic rafters, walls, and under floors. They are manufactured to fit joist or stud spacings of 16" or 24" centers and in varying thicknesses, 4' or 8' long. Batts are well suited for use in areas relatively free of obstructions and are easy to install because of the small sizes. Both types of batts are fire resistant and moisture resistant.

BLANKETS: Insulation blankets are similar to batts in most respects except that blankets are supplied in rolls. They are available in a glass fiber material or rock wool material and are also available with or without a vapor barrier. Since it is supplied in rolls, blanket insulation may be slightly more difficult to install. Blankets may be used in any of the areas listed for Batts.

LOOSE FILL (POURED-IN): Loose fill poured-in type insulation is available in glass fiber, rock wool, cellulosic fiber, vermiculite, and perlite materials. The poured loose fill insulation is especially convenient for use in unfinished attics and areas of irregular spacing of framing or where there are many obstructions. The material is usually packaged in

bags. Vermiculite and perlite are especially well suited for pouring in concrete block cavities. Glass fiber and rock wool loose fill material is fire resistant and moisture resistant. Cellulosic fiber is chemically treated to be fire resistant and moisture resistant. Labels on packages of cellulose materials should clearly indicate the material meets Federal Specifications. Cellulosic fiber has about 30 percent more insulation value than rock wool for the same installed thickness. Vapor barriers must be bought separately.

LOOSE FILL (BLOWN-IN): Blown loose fill material is available in glass fiber, rock wool and cellulosic fiber materials. It has the same physical properties as the poured loose fill material, but it must be applied with a blowing machine. It can be used in finished and unfinished attic floors, and finished walls. When blown into a closed space, enough material must be blown in to fill the entire space. If any of these materials are blown at a less density than specified to obtain a given R-value, the material will tend to settle and give poor results. All blown materials should meet Federal Specifications for fire resistance and moisture resistance. Vapor barriers must be bought and installed separately.

FOAMED IN PLACE: Ureaformaldehyde is a type of foam insulation that is used primarily in finished frame walls or as a fill material in masonry walls. It must be applied with a mixing and foaming machine. It has a slightly higher insulation value per inch of thickness than other blown-in materials. The quality of the installation is very dependent on the applicator because improper application can result in severe shrinkage of the material in the curing process.

<u>RIGID BOARD</u>: Rigid insulation boards are available in extruded polystyrene, expanded polystyrene, urethane board and glass fiber boards of a wide range of thicknesses. Rigid insulation boards are normally used on masonry walls, concrete slab floors, and air ducts. Many contractors are using rigid insulation boards to replace sheathing in standard frame construction. Urethane and extruded polystyrene board have higher insulation values than most other insulating material. The urethane and extruded polystyrene material forms its own vapor barrier. Expanded polystyrene and glass fiber boards are not vapor barriers. Polystyrene and urethane insulation board must be covered with 1/2" gypsum wall board to assure fire safety.

Materials used for insulation shall be of proven effectiveness and adequate durability to assure that required performances concerning heat losses, fire ratings, moisture absorption, and corrosiveness is met.

Labeling of insulation shall be as follows;

a. <u>Batt or blanket</u>: Insulation type, manufacturer or distributor, and R-value of the fiber at the labeled thickness in accordance with Federal Specification HH-I-521-E.

b. <u>Blowing or Pouring Type for Use in Open Horizontal Areas (Attics)</u>: Name, manufacturer, recommended installation density, R-value, marking on bag or packaging of conformance with Federal Specification HH-I-1030 A or HH-I-515C.

WATER VAPOR AND VAPOR BARRIERS

WE CAN PREVENT OR CORRECT CONDENSATION

We have at least five ways to prevent condensation in buildings. Once we understand how to control it, there is no more reason to build a house that develops internal dampness than there is to build a roof that leaks from the day it is finished. Every building that shows internal or hidden dampness due to condensation is violating one or more of the known principles. While the correction of existing difficulties may require skill to judge the conditions, it is not difficult to design and erect new buildings that will be entirely free of condensation problems.

Evolution of Condensation Troubles--In Frame Houses

For many years people believed that all the moisture found indoors came from outside--through leaks in roofs and walls, or from fog or dampness entering the house on very moist days. Many good roofs and flashings have been "repaired" that never had a leak. Now we know that most moisture originates within or under the building, and that problems of condensation can be easily avoided and oftimes corrected after it occurs.

Years ago, the building industry was not concerned with condensation, for it seldom occurred in frame houses except on windows without storm sash. These old houses were so loosely constructed that the exchange between outside and inside air, due to leakage, was sufficient to control excess humidity within the house. Houses were built with walls that had infiltration leakage and were uninsulated; the space within the walls was warm because of heat loss. Moisture did not condense within these warm walls. Instead, the warm moist air passed out into the open air.

*This section courtesy of the University of Illinois Small Homes Council-Building Research Council.

Condensation troubles began when the desire to save fuel brought into being tightly constructed homes. These were built without effective moisture controls. The tighter walls (resulting from the use of weather-stripping, storm sash, caulking, and insulation) prevented the warm, moist air from leaking out of the house; thus, water vapor accumulated within the house. In these improved houses the space within the walls was cold because the insulation reduced heat loss into the walls. However, the walls were still porous to the passage of water vapor. Warm, moist air from the rooms passed through the inner surfaces of the outer walls and the water vapor, if excessive, condensed when it reached cold surfaces within the walls.

THE CURES FOR CONDENSATION

To know the percentage of relative humidity is only of academic importance. It is more important for the home owner to know the preventative measures or cures for condensation problems. There are five methods for curing or preventing moisture condensation in insulated buildings. These are:

1. Stopping moisture at the source.
2. Ventilation. This refers to bringing in fresh cold air from the outside during the winter to absorb the moisture which accumulates within the air inside the house.
3. Installing vapor barriers to prevent moisture from moving from warm spaces to cold spaces where condensation will occur.
4. Cold-side venting. This refers to ventilation of the attic and of the exterior walls between the insulation and the outside surface.
5. Dehumidification by mechanical or chemical means.

The first four are more economical. The last is only useful to reduce the relative humidity when the source of moisture is not extreme. By discussing each of the four economical techniques one at a time, in the light of specific examples, it is possible to understand the principles involved.

Stop Moisture At the Source

Water, whether from outside rain or snow or from humidity originating inside or below the house, must be controlled to correct or prevent problems of moisture condensation.

Correct Surface Drainage

All rain water should be drained away from the house, whether it is built over a basement or a crawl space. Make sure that the ground slopes away from the house and no water is allowed to collect within ten feet of the house. Minimum grading specifications require a slope of 6 inches within 25 feet of the house on all sides. Make sure that the drainage ditch collecting this water also slopes to carry the water away from the site.

Water near the footing of the foundation should be collected in footing tiles having open joints and connected to an adequate storm sewer. If the storm sewer is not reliable, lead the drain tile into an open ditch that is lower than the footing or a dry well that is filled with sand and gravel.

Prevent roof water from collecting on the ground next to the house. A 3-foot overhand on one-story houses provides this protection. If the house is two stories or the eave projection is less than two feet, gutters and downspouts should be installed. If the storm drain is subject to back-up, divert the downspout water from the house by concrete splash blocks at least 30 inches long.

Vent Clothes Dryer

The use of mechanical ventilation to exhaust moist air from a clothes dryer can be classified as eliminating moisture at the source. Clothes drying is probably the most important single source of moisture originating in a normal household. As much as 26.4 pounds of water can be evaporated in a day by doing a week's laundry for a family of four. An automatic clothes dryer should be connected to a short vent duct leading outside, preferably without any turns, and less than 8 feet long. It is a mistake to ever vent the exhaust from a dryer into the attic.

Clothes washing in a wringer washer for a typical family of four would release 4.3 pounds of moisture. If the clothes were washed in an automatic clothes washer, very little moisture would be released. Humidity generated in the air by respiration from a family of four persons, after making normal allowance for children's time away at school and husband's time away at work, would be approximately six pounds per day. House plants are only a moderate source of moisture. A group of seven house plants, for instance, would only release one pound in 24 hours. Greenhouses and swimming pools which are attached to the house are a constant source of excess moisture and require special engineering analysis to avoid condensation problems.

Crawl Space

After the laundry, the most common source of moisture leading to trouble within the house is the water evaporating from the surface of the ground in a crawl space. Such moisture can come from ground water or from misdirected surface water. Capillary rise of ground water is by far the most common. Water can rise in soil by capillary action as far as 18

feet. Such moisture evaporates into the air of the crawl space even though the surface appears dry, and can rise up through openings around heat ducts, wiring, and plumbing, through the stud spaces and up into the house, walls, and attic, where it condenses. The first symptoms might be water collecting in the light fixtures. This will not occur if the house is built in an area with sandy or rocky subsoil which keeps the ground water always at least 18 feet below the crawl space. Where the ground water is within 18 feet of the surface in a crawl space of 1,000 square-foot house, as much as 19 gallons (162 pounds) of water can be released into the air during a single day. In some houses this source of moisture may be easy to detect by fungus on lumber, damp earth, mold on ground, damp foundation walls, or condensation on water pipes.

In many houses, however, symptoms of excess moisture are not visible. In fact, the ground may appear perfectly dry, with large cracks. This merely means that the moisture is coming up by capillarity until it reaches one of those cracks. It then evaporates and travels through the air to all parts of the house. The moisture travels independently of the direction of air flow. Increases of vapor pressure, regardless of the cause, may eventually lead to condensation anywhere.

To determine whether there is capillary rise in the ground under the crawl space, place a square yard of glass, or vapor barrier material such as polyethylene film on the ground. Seal it around the edges to prevent the escape of moisture, and place a few pieces of dry ice above. If there is moisture in the ground, water vapor will collect on the bottom of the glass or plastic within an hour.

Ground Cover

Moisture from capillary rise can be reduced by 90 percent by use of a vapor barrier type of ground cover. It is best to use one that is not susceptible to damage by fungi, such as polyethylene film 4 to 6 mils thick. Roll roofing weighing 55 pounds per 100 square feet is a good vapor barrier, but is subject to deterioration from fungi. All of the ground should be covered, and the ground cover turned up along the foundation walls 4 to 6 inches. Where more than one piece of polyethelene is needed, lap the edges 4 to 6 inches--sealing is not necessary. Use of wide rolls of ground cover reduces the number of edge joints.

Crawl Space Subject to Flooding

Crawl-space construction is not recommended if the space under the house is subject to periodic flooding. In event the crawl space floods, every effort should be made to control the water by surface drainage or footing drainage. If the flooding occurs only in the summer, a ground cover can be used. In that event, the surface of the ground in the crawl space should be sloped and the cover should be removed from the lower area each spring and replaced each fall.

There is no practical way to adequately protect a house from the moisture if the crawl space floods in the wintertime, unless the flooding can be controlled by outside grading or footing drains. A new house should never be built on a low, undrainable site. Once a house is built on such a site, the best solution is to cut openings in the foundation with a combined area that is equal to 5 percent of the crawl space area, and to insulate the floor above. The house should also be protected from

any moisture created by flood water in the crawl space. Both insulation and a vapor barrier can be provided by a continuous layer of polished aluminum foil installed on the bottom of the joists. A second layer of foil between the joists, and separated from the other foil by at least one inch will improve the insulation. Although there is risk of moisture from the air in the house condensing above the aluminum foil, this risk must be taken if the flooding cannot be corrected. See Crawl Space Houses, Circular F4.4, for an illustration of reflective foil insulation of floors.

Ventilation of the House

Once we appreciate that warm air can, and usually does, hold a great deal more water than cold air, we can understand the benefit of bringing in fresh air from the outside in order to reduce humidity. To understand this, visualize two glasses showing the amount of moisture normally found in the air of a typical living room (about 2,000 cubic feet) in the winter. One contains the water that the air could hold as moisture at 0°F. at 100 percent relative humidity, or fully saturated (1/9 pint). The other has 2/3 pint or six times more water. This can be held in the same quantity of air at 70° F. at 30 percent relative humidity, a fairly normal condition in houses. A 25 x 40 foot house, without basement, has a volume of 8,000 cubic feet. It requires only four pounds of moisture to raise the relative humidity of the 8,000 cubic feet of air from 15 percent to 60 percent at normal room temperature.

Cold outdoor air brought into a heated house--by drafts through cracks, open windows or doors, or mechanical ventilation can hold much more moisture when it is warmed up indoors, thus reducing the relative humidity

in the house. However, ventilation can effectively control the humidity in the house only if the major sources of moisture described above are controlled. Ventilation will, of course, increase the heat load and therefore the fuel bill, but it may reduce the humidity enough to prevent condensation.

Mechanical Ventilation

If natural ventilation is not sufficient, electric exhaust fans in the kitchen and the bathroom may be desirable. A fan will be most effective if it is operated by an automatic switch controlled by humidity. Ducts carrying warm, moist air from the kitchen and the bathroom should be short (preferably less than 8 feet), should have only one, or at the most two, turns and should lead outside the house.

Vapor Barrier

Even though all reasonable measures are taken to ventilate and stop excess moisture at the source, some moisture may remain in the air of the house. This should not be allowed to penetrate into the attic or unvented cold walls. The vapor in the air within the house create a pressure much like any other gas. The more there is, the greater the "vapor pressure." For practical purposes, it is sufficient to know that cold air, even though saturated, has a comparatively low vapor pressure. As it picks up moisture, warm air develops a greater vapor pressure. Warm air laden with moisture has a high vapor pressure. The difference is very real. While we cannot feel it, this pressure may be measured in terms of pounds per square foot. This pressure easily accounts for some of the things water vapor can do, such as penetrate many building materials.

Vapor will travel wherever air can travel, and through many materials apparently impervious to air. A piece of acoustical tile, for example, appears to be relatively solid, and we might assume it to be vapor resistant. It is actually made up of many small air cells, each interconnected, and when you blow against one side, you can feel it coming out on the other side with your hand. This passage for air is also a suitable passage for vapor. Most of the commonly used insulation and wallboards are porous to vapor, even though at a low rate.

Use of a vapor barrier is the most direct means to prevent interior moisture from passing into the outside walls and attic. The barrier should be applied to the warm side of exterior walls or ceilings. It may be an integral part of the wallboard or plaster base, or it may be an independent sheet of material. Since condensation is most apt to occur in climates where the average January temperature is 35°F. or colder, vapor barriers should be used in those areas--in other words, north of the Ohio River in the central United States. If exceptionally high indoor humidities prevail, however, vapor barriers should be used even further south.

If a vapor barrier is to be used, it must be continous and unbroken to prevent the passage of moist air through any cracks. All joints must be lapped and securely fastened to studs, joists, or bracing. It is common practice to install batt insulation with a vapor barrier on the warm side. Frequently the vapor barrier for the batt is stapled to the sides of the studs, thereby providing a gap around the edge of the batt. Aluminum foil vapor barrier on the back of plaster base or wallboard can

be installed with fewer cracks and gaps between the sections of vapor barrier. It is important to avoid these cracks and to seal all of the openings around light fixtures and plumbing pipes. This will keep moist air out of any spaces where it can flow from walls and interior partitions into the attic.

In houses which are built tightly, such as those that are planned for electric heating, there is a greater tendency for vapor levels to built up. In such houses the joints between pieces of foil-back wallboard or lath allows too much moisture to move into the walls. A better seal can be achieved with a continuous vapor barrier, such as a polyethylene film. This is applied after the insulation is in place and the rough plumbing and electrical work are done. Then only minimum openings need to be cut for electric outlets and to fit around the plumbing stacks. Also, the joint between the ceiling and the wall vapor barrier can be sealed.

Paints and surface coatings are the least effective type of vapor barrier. Paints which are effective as a vapor barrier include most aluminum, asphalt, and lead and oil paints, and varnishes. Water-emulsion paints as a group are not good barriers. Usually two or three coats of oil-base paint are required for satisfactory results.

Cold Side Venting

No matter how we try, we cannot always reduce the amount of moisture indoors, and improve the vapor seal sufficiently to prevent all moisture from penetrating through the walls or ceilings and reaching the areas where it can condense and cause damage.

Another basic way to overcome this problem is to let whatever vapor gets into the outside walls or attic keep flowing to the outside. Under these conditions, moisture will not condense. We can do this by venting the cold side to the outdoor air, as is commonly done in well-ventilated attics, or simply by using materials on the cold side that are at least five times more porous to water vapor than those assembled on the warm side. This is automatically done with brick veneer or stained siding on walls.

Back Venting Siding

If the vapor sealing quality of the outside finish material is high, as with most paints, it is generally far simpler to plan for cold-side venting to remove the moisture which accumulates. But even a siding with a vapor-porous stain may eventually be covered with paint. It also can best be protected from future condensation problems by cold-side venting. The siding should be nailed to furring strips that are nailed over sheathing, which is covered with light building paper. The air space behind the siding should be open at the top and bottom to allow outside air to flow through and remove any condensed moisture from the back of the siding. If brick veneer is painted, the air space between the brick and the sheathing can be ventilated by opening vertical brick joints at the bottom and top of all brick areas.

Attic Ventilation

Asphalt shingles seal vapor into the attic. Wood shingles laid over spaced sheathing are vapor porous. Whenever the roofing is resistant to vapor passage, cold side venting must be used to remove moisture from the

attic. But most authorities recommend controlling the moisture and keeping it from the attic as even more important than increasing attic ventilation. Following are four factors which influence moisture control in attics:

1. The rate that moisture originates in and under the house.
2. The vapor resistance of any barrier in the ceiling.
3. The vapor permeability of the finished roofing.
4. The net area of cold side venting and the difference in wind pressure on the inlet and outlet vents in the attic.

With ideal conditions of the first three, little or no attic ventilation will be required. If the roof is covered with asphalt shingles, or wood shingles on plywood or tight sheathing, and if normal precautions are taken to limit or remove moisture originating in or under the house, the free area of the attic ventilators should be at least;

1/300 of the attic area if there is a vapor barrier in the ceiling. (i.e. the house with 1,000 square feet of attic area will require vents with a combined area of 3 1/3 square feet.)

1/150 of the attic area if there is no vapor barrier in the ceiling.

The free vent area is not equal to the framed opening of the vent. It is necessary to make allowances for obstructions when computing the free area of vents. In case of wood louvers, it is customary to assume that the free area is about 1/2 the gross area of the opening inside the frame. With metal louvers, the free area may be 80 percent of the opening

inside of the frame. Wire mesh, which is important to keep out insects, will reduce the effective area even more. A 1/8-inch mesh screen reduces the effective area 25 percent. A 14/16 mesh screen should not be used because it will virtually stop all air flow except when the wind is blowing hard.

The vents should be located so the wind pressure can force a limited amount of air into and out of the attic, but so as to minimize problems of rain and snow penetration. This can be done by wind baffles and by providing half the ventilation low and half high in the attic. Vents in gable end walls may provide good air circulation, but are subject to rain and snow penetration. Vents under the soffits of projecting eaves limit rain and snow penetration, but additional vents high in the attic are necessary to assure air flow when winds are mild.

A series of low-profile roof vents near the peak, or a ridge vent with snow baffles, can ventilate the high section of the attic and keep out most wind-driven rain or snow, but high vents alone are not adequate. A combination of under-eave vents and ridge vents or high vents is ideal.

The total number of vents required depends upon the type of vents and the type of roof. Following is an example of the calculation for determining the size of vents required for a hip roof house with a 25' x 40' (1000 sq. ft.) attic and a vapor barrier in the ceiling.

The net vent area should be 1/300 of 1000 sq. ft. or 3 1/3 square feet, with 1 2/3 square feet high and 1 2/3 square feet low.

An aluminum ridge vent, that is commercially available, has a screened vent 1 1/4 inches wide on each side of the ridge (or a gross

area of 30 sq. inches per running foot). Making allowance for the metal louver and the 1/8-inch screen mesh, the free area of one foot of ridge vent is 30 x 80% x 75% which equals is 18 square inches or .125 square feet of net vent area per foot of ridge vent. Fifteen lineal feet of this ridge vent will provide 1.875 square feet of vent, which is slightly over the required 1 2/3 square feet.

The low vents can be provided by metal under-eave vents with a 4 x 10 inch area, which equals 0.278 square feet. Making allowance for the metal louver and screen mesh, the free area would be 0.278 x 80% x 75%, or 0.167 square feet per vent. Hence, 10 such vents will provide a net of 1.67 square feet low ventilation area, as required.

Without a vapor barrier in the ceiling below the attic, the required ventilation area would be 1/150 of the attic area or twice as much. This could be provided by 20 instead of 10 soffit vents and by extra low-profile roof vents near the ridge.

If these cold-side venting procedures were more commonly used, it is very unlikely that we would receive so many hundreds of letters per year requesting advice on how to overcome attic condensation, paint peeling, and other moisture condensation problems.

Dehumidifying

Mechanical and chemical dehumidifying is useful in drying the air of a room or two, but cannot relieve excess humidity throughout a house. A mechanical dehumidifier is essentially a small refrigeration unit in which the cooling coil is exposed to the air in the room. The moisture in the air condenses on the coil, since it is colder than any other surface in the room. The water so collected is drained away.

It is also possible to dry moist air with calcium chloride and similar chemicals which absorb moisture from the air. The salt turns to a liquid when moisture is absorbed. This liquid must be disposed of and the salt replenished daily. Keep the liquid away from vegetation and also, because it is highly corrosive, wash it from the metal surfaces.

Thus we see that there are four ways to prevent condensation in buildings. If excess condensation occurs, it is evidence of either faulty design, faulty assembly of materials, or improper control of generated vapor. During very cold weather, the appearance of frost on single glass is a good signal for cutting off the humidifier and providing ventilation. If any moisture appears on the inner surface of double insulating glass, a danger signal if flying. This shows that the humidity is too high for the safety of the structure. Don't try to pour any more vapor into the indoor air of such a house. While people can tolerate more moisture, condensation will occur within the structures as well as on windows, walls, and ceilings.

VENTILATING ATTICS

Ventilation is as necessary in winter as in summer. In winter, the insulation keeps heat within the house while the open vents let moisture vapor escape. In summer, ventilation carries off warm air.

Always provide at least two vent openings. They should be placed so that air can flow in one, over the insulated area, and out the other. If natural ventilation is difficult to achieve, power ventilators may be installed.

VENTS

Four kinds of vents are recommended.

Gable vents. Under normal conditions, gable vents can do an adequate job of ventilation, when enough free vent area is provided. If there is a vapor barrier in the ceiling, the free vent area should be at least 1 square foot for every 300 square feet of attic area. Without a vapor barrier, there should be a free vent area of 1 square foot for every 150 square feet of the attic area. Vents should be kept open year round.

Ridge and eave vents. This is an excellent way of venting at the top of the roof where the pressure is the greatest, and the eave vent provides cross ventilation. Be sure that ceiling insulation does not block any of the eave vents.

Roof vents. These provide good ventilation, provided adequate free vent area is available. Roof vents are particularly good in combination with eave venting. Roof vents should be placed high on the roof.

If vents are protected by screening or rain louvers, the recommended opening size should be increased as shown in the table below:

Type of Covering	Size of Opening
1/4" hardware cloth	1 x net vent area
1/4" hardware cloth and rain louvers	2 x net vent area
8-mesh screen	1¼ x net vent area
8-mesh screen and rain louvers	2¼ x net vent area
16-mesh screen	2 x net vent area
16-mesh screen and rain louvers	3 x net vent area

VENTILATING CRAWL SPACES

Foundation vents. Any house with a crawl space needs foundation vents. In addition, a polyethylene ground cover of at least 4-mil thickness or 55-pound roll roofing should cover the earth in the crawl space. Ground cover should be lapped 4 to 6 inches--sealing is not necessary. The ground cover should be turned up along the foundation walls 4 to 6 inches. With a correctly installed moisture seal, one square foot of vent should be provided for every 1,500 square feet of crawl space. A minimum of two vents is required, and they should be placed so that air flows in one, through the crawl space, out the other.

When no ground cover is installed, one square foot of vent is required for each 150 square feet of crawl space, and at least four vents are necessary. Foundation vents should remain open all year.

AREAS OF EXCESSIVE INFILTRATION LOSSES

Windows and Doors - Loose fitting windows and doors should be refitted and weatherstripped. Caulking should be applied to all cracks, especially at windows and doors, where air can enter the home. For further information on weatherstripping and caulking, refer to those sections in the publication "In The Bank or Up The Chimney."

Attic Access Doors and Pull-Down Stairways - Uninsulated and poorly fitted access doors and pull down stairways should be tightly closed and batt insulation attached to the attic side of the door or stairway.

Fireplaces - All fireplaces should have a damper that will effectively close off the chimney. If there is no damper, the opening should be closed off by another method.

Window Air Conditioners - All window air conditioners should be sealed around the cabinet and covered to prevent air entrance around and through the unit.

Exhaust Fans in Conditioned Space - Exhaust fans should have dampers or louvers that close when the fan is not operating. If there are no dampers or if dampers are stuck in the open position, a draft similar to that caused by a chimney will occur.

STORM WINDOWS AND DOORS

Storm windows and doors may take 7 to 10 years or more to pay for with savings in fuel costs, but they do make a house more comfortable by reducing drafts around windows and doors. They also help by reducing window sweating and outside noise.

Tacking plastic sheets over the outside of windows or taping them on the inside will give the same savings as permanent-type storm windows. However, they do not look as nice and they generally have to be replaced every year.

For further details, see "In The Bank or Up The Chimney."

Materials and Installation Techniques

Thermostats

To save money on your heating bill, you may want to turn your thermostat back to 65° or 60° at night. A convenient way to be sure you do this each night is to install a clock thermostat. It will automatically turn your thermostat down every night and turn it up in the morning before you get up. You won't be uncomfortable with the temperature—or with your heating bill.

Caulking and Weatherstripping

Materials

Caulking and weatherstripping come in a variety of qualities, costs, and configurations. You should buy, whenever possible, the best quality available. The more durable materials are the best money savers. They perform better and don't need to be replaced as often. Check below for a brief description of the most commonly available materials.

Caulking compounds

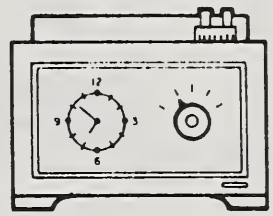
1. Not very durable but lowest in cost: oil or resin based.
2. More durable and more expensive: latex, butyl, or polyvinyl.
3. Most durable and most expensive: elastomeric base.

Filler

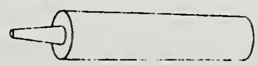
Material used to fill extra wide cracks: oakum, caulking cotton, glass fiber. Apply caulking compound *after* using filler.

Weatherstripping

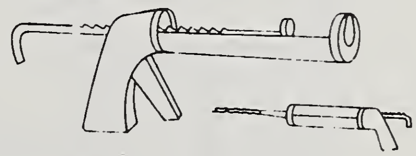
1. Inexpensive, easy to install, not very durable: felt or foam strip.
2. More expensive, easy to install, durable: rolled vinyl (with or without various backings).
3. More expensive, somewhat difficult to install, very durable: thin spring metal.
4. Most expensive, very difficult to install, excellent weather seal, durable: interlocking metal channels.



Cartridge



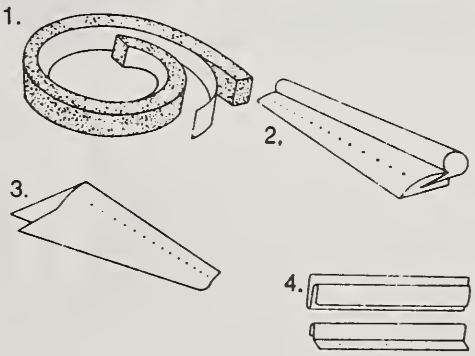
Caulking Gun



Filler

Weatherstripping

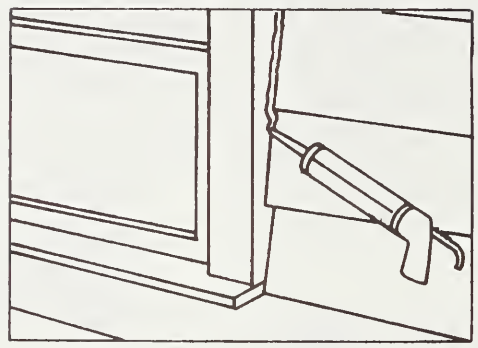
1.



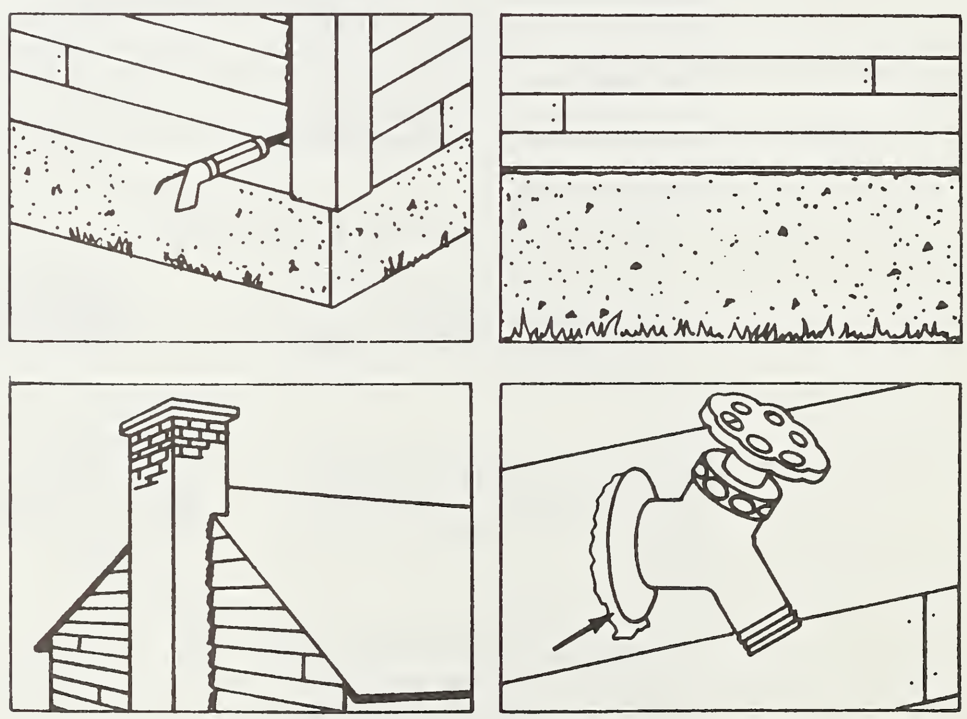
Source: Federal Energy Administration

Installation

Caulking should be applied outside around window and door frames . . .

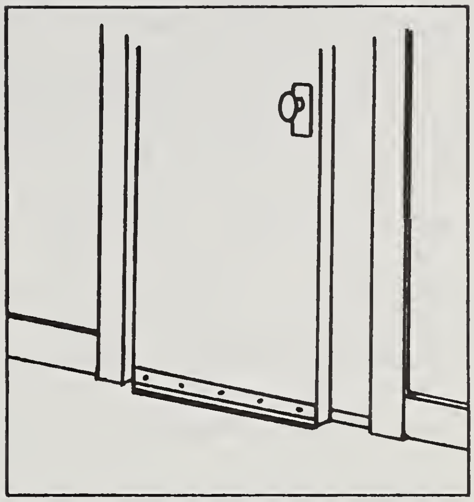


. . . . and wherever else two different materials or parts of the house meet.

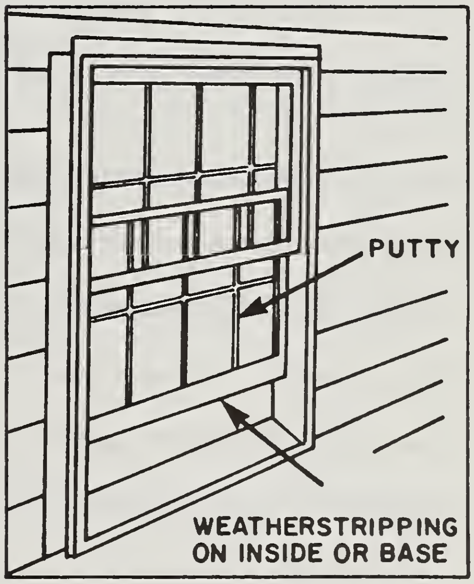


Source: Federal Energy Administration

Weatherstripping should be applied around the perimeter of all exterior doors and on the inside of all window sashes.



And while you're at it, check to see if the putty on your windows needs replacing. Cutting down on *all* drafts will make your house much more comfortable year round.



Source: Federal Energy Administration

THE ELECTRIC HEAT PUMP

"...conserves energy like nothing else..." The heat pump is a central heating and cooling system. It cools like any other central air-conditioning system, but it also is the most efficient heating system you can buy.

In order to understand why it is such an efficient heating system, you must remember that there is some heat in even the coldest outside air. The heat pump, as its name implies, extracts this heat and pumps it into your home. During the heating season in the TVA area, one unit of electrical energy used to power the heat pump will provide approximately two units of energy in the form of heat. The heat pump itself doesn't really produce heat, but moves it from the outside to the inside of your home. During the summer it reverses the cycle and removes the heat from inside your home just like a conventional air conditioner.

"...saves on your heating bill..." Heat pumps in the TVA area will average a seasonal performance factor of about two. This means that during the winter the heat pump has an efficiency of about 200 percent. For example, if one home has a central electric furnace and the heating cost if $200, an identical home next door using a heat pump would probably have a heating bill of about $100. As you can see, savings on the heat bill alone can pay for a heat pump.

"...saves natural resources, too..." Since the heat pump operates so efficiently, it greatly reduces the number of kilowatt-hours needed for heating your home. This, in turn, means that less coal or other fuel will be burned at the generating plant where the electricity is produced. An average 1,500-square-foot home using a heat pump would save the equivalent of more than three tons of coal each season.

INSULATION OF DUCTS

DUCT SYSTEMS - If ducts for either the heating or air conditioning systems are run exposed through the attic or garage (or any other space that is not heated or cooled), they should be insulated. The rate of heat loss or heat gain through uninsulated ducts is very high in both supply and return air systems. Duct insulation comes generally in blankets 1 or 2" thick. The minimum recommended thickness is 2" with a vapor barrier. The ducts should be wrapped with the insulation with the vapor barrier on the outside and lapped 2" at each joint. All joints should be securely stapled and sealed with duct tape. The insulation should fit snugly, but should not be pulled so tightly that it becomes compressed. Check for air leaks in the duct, and tape them tightly before insulating.

It is very important that air filters are clean. The filters may be of the permanent or semi-permanent type which can be washed. Many systems use a throw-away type filter which must be replaced when dirty. Dirty or clogged air filters will cause very inefficient operation and can cause damage to equipment.

How often should filters be replaced or cleaned? Some manufacturers offer as an accessory, an indicator light which signals when the filter is dirty and needs cleaning or replacing. If the unit doesn't have this feature, you should change or clean the filters at least every three months. And never operate the unit without filters.

MOBILE HOMES - Mobile homes present special problems for energy conservation techniques. Although it is usually more difficult to reduce energy waste in a mobile home, there are some steps that are very worthwhile.

1. The area beneath the floor should be enclosed with a rigid plastic or galvanized metal sheeting. This will shut off the sweep of cold winter air under the floor. Adequate openings should be left for ventilation.
2. In some cases insulation can be added in ceilings and walls by professional insulation contractors.
3. Insulation batts (minimum of R-11) can be added to the floor by lacing a wire support across the bottom of the mobile home.
4. All air leaks into the living area around pipes and fittings should be sealed to prevent infiltration of cold air.
5. The addition of storm windows will reduce heat losses and improve comfort in a mobile home in the same way as in standard construction. Use of a plastic material is an economical method of installing storm windows.

COOPERATIVE EXTENSION SERVICE
University of Arkansas Division of Agriculture
and
United States Department of Agriculture, Cooperating

ENERGY EFFICIENCY IN NEW CONSTRUCTION

Heating and cooling equipment is the major energy consumer in the average Arkansas home. It is estimated that 65 percent of the annual energy consumption in a typical home is for heating and cooling; about 15 percent for water heating; and the remaining 20 percent for lighting, cooking, and the operation of household appliances. Therefore, significant reductions in residential energy consumption must encompass more thermally efficient construction.

Factors that affect the thermal efficiency of a dwelling are as follows:

1. Orientation
2. Location and type of trees about the building site
3. Size of the structure
4. Amount of insulation in ceiling, walls, and floor
5. Size, location, and type of windows
6. Type of exterior doors
7. Attic ventilation
8. Selection and installation of heating and cooling system
9. Amount of air infiltration into the structure
10. Relative humidity inside the home

If proper attention is given to the above-mentioned items, heating and cooling costs can be held at a minimum. Keeping them at a minimum will depend on family life-style, maintenance of the heating and cooling equipment and keeping the thermostat set at a conservative temperature. A difference of 1°F. in the thermostat setting can result in 3 to 5 percent difference in energy consumed for heating or cooling. Therefore, warmer settings in the summer and cooler settings in the winter can yield significant savings.

ORIENTATION

Locating the dwelling on the building site so the narrow ends of the structure face east and west is desirable. Normally, this means running the main gable east and west. This orientation exposes a minimum of wall and roof surface to direct summer sun, resulting in a reduced amount of solar heat gain. This same orientation also provides a desirable southern exposure to the winter sun. If a structure can be located with the rear of the dwelling facing south, it may provide an excellent opportunity in future years to add solar collectors to the rear roof slope.

TREES

Deciduous trees will provide summer shade, and then shed their leaves to let the winter sun through. Trees on the west side of the dwelling are most signficant, but those located to the east and south can be very beneficial.

SIZE OF THE STRUCTURE

Large homes cost more to build and furnish, more to maintain, and more to heat and cool. Therefore, many families are paying closer attention to building only space that is absolutely necessary for their family. Proper planning for space arrangement, traffic patterns, and family life-styles must be considered. Many families are finding that they cannot justify the added costs of guest bedrooms, formal living rooms, and formal dining rooms.

INSULATION

A measurement of the resistance to heat flow through a material is R-factor. Insulating materials are rated in terms of R-factor, and this should be the basis for selection rather than inches of thickness, because different insulating materials have different R-factors. For example, a 6-inch batt of glass-fiber insulation has an R-factor of 19. It takes about 8½ inches of typical blown glass-fiber insulation to get R-19, or 5 to 6 inches of a typical application of blown cellulose fiber to equal R-19. When buying insulation, consider not only the R-factor, but also flammability, resistance to rodents, deterioration with age, possibility of settling or shrinkage, and cost.

Most insulating materials (some foams are the exception) require the application of a moisture barrier on the warm side of the insulation (interior side of the ceiling, wall, or floor). Examples of

materials that serve as suitable moisture barriers are polyethylene film, aluminum foil, and tar-impregnated paper.

CEILING

Arkansas homes should have a minimum of R-19 insulation in the ceiling, but increasing fuel costs have made greater amounts of insulation feasible. A "super-insulated" house should have about R-28 to R-30 attic insulation. The thickness of this amount of insulation will vary from around 9 inches up to 13 or 14 inches depending on the R-factor of the insulation used. Two applications that are commonly used are (1) about 12 inches of blown glass-fiber or (2) a 6-inch batt of glass-fiber insulation with about 6 inches of blown insulation on top to seal it over.

Care should be taken not to stop up the soffit (roof overhang) ventilation with the increased thicknesses of insulation. To avoid this problem, the insulation will have to be tapered off at the side walls to about 6 inches, or the attic framing can be modified to allow a full thickness of the ceiling insulation to extend all the way to the side walls of the house.

WALLS

The minimum insulation for walls is R-11 (a 3½-inch glass-fiber batt is normally used). Higher fuel costs have made increased wall insulation more feasible. For a "super-insulated" house, about R-19 insulation is recommended. There are two "popular" ways to build a "super-insulated" wall.

The first is to use conventional 2 x 4 stud framing 16 inches on center. The wall is sheathed on the exterior side with foam insulation (diagonal let-in braces must be used for corner braces to strengthen the wall, and care must be taken to apply the material so moisture is not trapped in the wall). Full thickness R-13 glass-fiber insulation is used in the stud cavity. The R-13 batt plus the foam provides about R-18 to R-19 insulation in the wall.

The other method is to use 2 x 6 studs framed 24 inches on center. The 2 x 6's are spaced farther apart to keep the cost of the wall framing competitive with the closer spaced 2 x 4 system, and the wider spacing allows a higher percentage of the wall to be insulated. A 6-inch, R-19, glass-fiber batt is placed in the stud cavity.

Either system has some advantages and disadvantages. Builders are using both systems, generally preferring the system their construction crew is accustomed to. The two methods of construction are approximately equal in energy efficiency.

FLOORS

Conventional (wooden floor) Arkansas homes should have a minimum of R-11 insulation under the floors; but again, increased fuel costs have made applications up to R-19 attractive for "super-insulated" homes. The typical installation for under-floor insulation is a 3½-inch (R-11) or a 6-inch R-19) glass-fiber batt. The moisture barrier is generally applied to the batt and should be applied face-up against the subflooring. The easiest way to hold the insulation in place is with wire clips spaced 15 to 18 inches apart under the batts. The wire is wedged between the floor joists and bites into the joist to hold the batt firmly against the subflooring.

SLAB

Concrete slab floors should be insulated around the edge with a rigid, non-absorptive type of insulation (styrene and urethane foam are excellent for this). A minimum of R-5 is recommended; but up to R-10 (1½ to 2 inches, depending on the type used) is desirable. Greater amounts may complicate construction because there may not be enough space to get it in place.

WINDOWS

Windows and doors are the greatest areas of heat loss in a house. Each square foot of double-glass window will transfer as much heat as 20 square feet of R-11 insulated wall. One square foot of single glass can equal 35 to 40 square feet of an R-11 insulated wall. Heat transfer through the glass, as well as air leakage around the windows, cause the problem. Therefore, window area should be kept to a minimum, all windows should be double glass (insulated glass or prime window plus storm window), and they should be certified against excessive air infiltration.

Windows should be sized and placed in a home to provide natural light and ventilation for the home, to enhance a particularly nice view from the home, to allow escape routes in case of fire (especially in sleeping areas), and to complement

the appearance of the house. Place windows in the front of the house to give the dwelling a pleasing appearance. Bedroom windows should be large enough and low enough to provide a fire escape. Use large areas of glass only where there is a worthwhile view, but avoid floor length windows. Be conservative, but place windows as necessary. If appearance is a problem, remember that small windows can be made to look larger with the use of panels under the windows and shutters to the sides.

EXTERIOR DOORS

Exterior doors should be thoroughly weather-stripped and covered with a storm door unless an insulated door is used. Steel-insulated doors that seal with a magnetic gasket when closed are available. These doors provide excellent insulation, even without the use of a storm door. They are available in any style and are not generally recognizable as a steel door.

ATTIC VENTILATION

Attic Ventilation Minimum Property Standards require natural ventilation at the rate of 1 square foot of ventilation area per 150 square feet of ceiling area or 1 square foot per 300 square feet if an effective vapor barrier is provided under the attic insulation. Cross ventilation must be provided and at least 50 percent of the ventilation must be located in the upper portion of the attic.

Increasing the amount of attic ventilation above the MPS requirements can result in lower attic temperatures during the summer months. A cooler attic results in a reduced cooling load through the ceiling. With small amounts of ceiling insulation, the attic ventilation rate is very significant; but with large amounts of ceiling insulation, attic temperature is less critical. Therefore, there is much speculation about how much attic ventilation is enough.

Natural ventilation can be very effective if increased up to as much as 1 square foot of ventilation area per 50 square feet of ceiling area. Half of this amount should be under the soffits with the other half as near the ridge as possible.

Power ventilators are effective in lowering attic temperatures and are generally sized for at least .7 cfm per square foot of ceiling area. It does require a small amount of power to operate these small fans, and they become more difficult to justify if large amounts of insulation are used in the ceiling.

HEATING AND COOLING SYSTEM

Shop around and buy equipment that will operate efficiently. Most gas-fired heating systems operate at about the same efficiency. However, if electric equipment is chosen, remember that a heat pump will operate at about one-half the cost of electric resistance heat. A heat pump is not completely without disadvantages. Heat pumps cost more to buy initially than electric resistance furnaces, they are more complicated to service, and they will generally cost more to maintain. Even so, in areas where competent and experienced dealers are located, a heat pump will be the wise choice if electricity is your choice of heating fuel.

When buying air-conditioning equipment, look for the EER rating (energy efficient ratio). It tells you how many BTU's of cooling are provided by each watt of electricity that the unit uses. The higher the number, the better. Air-conditioning equipment will typically range in EER ratings from 5 to 10 or 11. Equipment with the higher EER rating will typically be more expensive. Try to select equipment with an EER of at least 7.

Heat loss from the duct system can be as much as 15 to 20 percent of the heating and cooling bill. This can be reduced to an insignificant amount by putting the duct system inside the living area of the house if possible. This allows all heat transfer through the duct system to be used in the living area of the house. Try to avoid running the duct system through the attic. Under the floor is a better choice from an energy viewpoint.

AIR INFILTRATION

It is desirable to have some fresh air and ventilation in a house. But, the amount should be carefully controlled. Excessive air infiltration costs money in terms of wasted BTU's. Build a house as tight as possible and then provide ventilation as necessary. Vent fans can be used in bathrooms, kitchens, and laundry rooms; and windows can be raised when necessary. Caulking, weather-stripping, storm windows, and plastic vapor barriers are all invaluable aids in controlling unwanted air infiltration.

HUMIDITY

The desirable relative humidity for an Arkansas home is about 45 to 50 percent.

Low humidity makes a house uncomfortable. Dryness in the nose and throat is experienced and cracks in woodwork and furniture may appear. Winter heating costs can be higher because high temperatures have to be maintained with low humidity to feel comfortable.

High humidity will also cause undesirable problems. Mold, mildew, musty odors, and excessively sweating windows can all be indicators of too much moisture in the home.

Summer humidity is normally controlled by the home air-conditioning unit. About a third of the energy used by a typical air-conditioning unit in Arkansas goes for removing moisture from the air.

Winter humidity control involves controlling the amount of ventilation air entering the home. A very tight home with an active family will generally have adequate winter humidity. A large house or an old home with much air leakage will generally have low humidity. Generally, low humidity can be remedied by tightening up the house and adding some moisture as necessary with humidifiers. High humidity can be controlled by ventilating or operating a dehumidifier.

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ENERGY CONSERVATION BULLETINS

Intermountain Rural Electric Association
Littleton, Colorado

ENERGY CONSERVATION BULLETINS

Bulletin Subject and Numbers

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1.2B.1/2/3/4/5	How to Insulate (Walls)
1.2C.1/2/3/4	How to Insulate (Floors & Basements)
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1.3.1	Insulation: R values, standards (performance & safety
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2. Heating and Air-Conditioning Investments

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ENERGY CONSERVATION BULLETIN 1.1.1
Buying Insulation

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Insulating Materials

Insulation is made from various materials. There is no one type that is best for all applications. They vary according to quality, thermal resistance ("R" value), safety features, dimensions, and where and how they are applied. When choosing materials, these factors should be considered. Described below are the most common materials:

Mineral Fiber — This is made from mineral substances such as rock, slag or glass, and is processed from a molten state into a fibrous form. Most commonly known as "glass fiber" (fiber glass) or "rock wool," it comes as blankets (rolls or batts) or loose fill. Rock wool can also be blown in place.

Cellulose Fiber — This generally comes in loose fill form, and is made from recycled paper or paper stock that has been defibered. It should be treated for fire resistance and other conditions by the manufacturer. It can be poured or blown in place.

Expanded Materials — These include vermiculite and perlite, and they usually come as loose fill. They can be poured into odd-shaped spots or smaller areas. Sometimes, this is a more expensive insulating material, for a given "R" value, than other types.

Foamed Plastic — As polystyrene, polyurethane and urea formaldehyde, these are preformed into boards or blown (foamed) into wall cavities by contractors. Foam insulation can vary considerably in its final properties depending on the operator's skill, how various reactants are mixed, and the time allowed for "curing." Foams possess other properties which may affect their long-term insulating value, such as moisture retention, shrinkage, spontaneous decomposition, and vermin resistance. Foams also burn, producing smoke and poisonous gases such as carbon monoxide. These hazards can be reduced by following the recommended installation procedures for each type of foam. Foam that is properly installed will have a higher insulating value but may be relatively expensive.

Types Of Insulation

Several kinds of insulation are available to homeowners. Kinds that are easily installed by the do-it-yourselfer are batts, blankets, and loose fill. Foamed-in plastic is usually installed by a contractor because special equipment is used. If your house has a flat roof or a mansard roof, or if your attic or basement area is otherwise restricted, installation will be difficult and you may need to hire a contractor.

BLANKETS — glass fiber, rock wool

Where they're used to insulate:
unfinished attic floor
unfinished attic rafters
underside of floors

- best suited for standard joist or rafter spacing of 16" or 24", and space between joists relatively free of obstructions
- cut in sections 15" or 23" wide, 1" to 7" thick in rolls to be cut to length by the installer
- with or without a vapor barrier backing
- a little more difficult to handle than batts because of size
- fire resistant, moisture resistant
- Most batts and blankets have an attached vapor barrier on one side. Many are totally enclosed, with a vapor barrier on one side and a vapor-permeable material on the other.

LOOSE FILL (poured-in) — glass fiber, rock wool, cellulosic fiber, vermiculite, perlite

Where it's used to insulate:
unfinished attic floor

- vapor barrier bought and applied separately
- best suited for non-standard or irregular joist spacing or when space between joists has many obstructions
- glass fiber and rock wool are fire resistant and moisture resistant
- cellulosic fiber chemically treated to be fire resistant and moisture resistant; treatment not yet proven to be heat resistant, may break down in a hot attic; check to be sure that bags indicate material meets Federal Specifications. If they do, they'll be clearly labelled.
- cellulosic fiber has about 30% more insulation value than rock wool for the same installed thickness (this can be important in walls or under attic floors).
- vermiculite is significantly more expensive but can be poured into smaller areas.
- vermiculite and perlite have about the same insulating value.
- all are easy to install.

LOOSE FILL [blown-in] — glass fiber, rock wool, cellulosic fiber

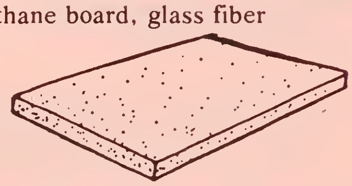
Where it's used to insulate
unfinished attic floor
finished attic floor
finished frame walls
underside of floors

- vapor barrier bought separately
- same physical properties as poured-in loose fill.
- Because it consists of smaller tufts, cellulosic fiber gets into small nooks and corners more consistently than rock wool or glass fiber when blown into closed spaces such as walls or joist spaces.
- When any of these materials are blown into a closed space enough must be blown in to fill the whole space.
- Loose fill which is blown into walls or other inaccessible areas should be installed by a contractor.

RIGID BOARD — extruded polystyrene bead board (expanded polystyrene) urethane board, glass fiber

Where it's used to insulate:

basement wall



NOTE: Polystyrene and urethane rigid board insulation should only be installed by a contractor. They must be covered with ½'' gypsum wallboard to assure fire safety.

- extruded polystyrene and urethane are their own vapor barriers, bead board and glass fiber are not.
- high insulating value for relatively small thicknesses, particularly urethane.
- 2 or 4 feet wide by 8 feet long
- variety of thicknesses from ¾'' to 4''
- They usually have a higher ''R'' value per inch of thickness than rolls or batts, and are used as external sheathing and perimeter insulation around foundations, and in new construction in side walls because they give the maximum ''R'' value for the space. Local fire regulations may prohibit certain types of board insulation, or require that others be fitted by a contractor — ask about this before buying.

BATTS — glass fiber, rock wool

Where they're used to insulate:

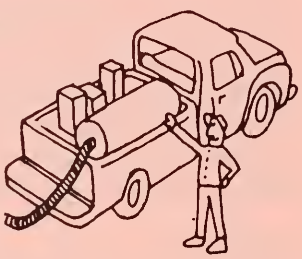
unfinished attic floor
unfinished attic rafters
underside of floors

- best suited for standard joist or rafter spacing of 16'' or 24'', and space between joists relatively free of obstructions
- cut in sections 15'' or 23'' wide, 1'' to 7'' thick, 4' or 8' long
- with or without a vapor barrier backing — if you need one and can't get it, buy polyethylene except that to be used to insulate the underside of floors
- easy to handle because of relatively small size
- use will result in more waste from trimming sections than use of blankets
- fire resistant, moisture resistant

FOAMED IN PLACE — unreaformaldehyde

Where it's used to insulate:

finished frame walls
unfinished attic floor



- moisture resistant, fire resistant
- may have higher insulating value than blown-in materials
- more expensive than blown-in materials
- quality of application to date has been very inconsistent — choose a qualified contractor who will guarantee his work.

Blankets, batts, and pouring insulation can be bought from building supply dealers and home centers. Blowing insulation is supplied by the insulation contractor who installs it.

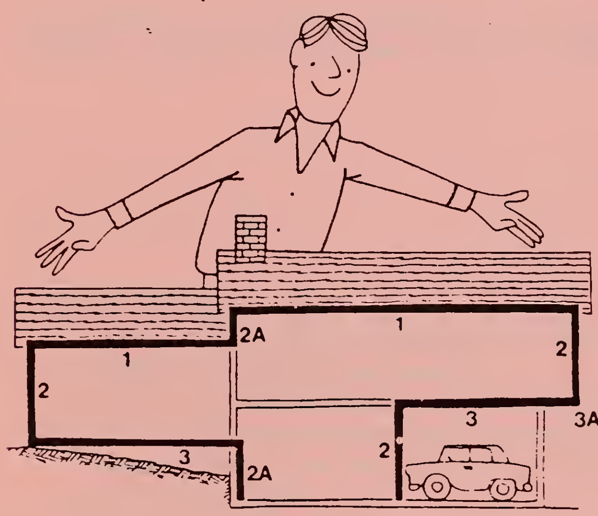
ENERGY CONSERVATION BULLETIN 1.2.1
How To Insulate

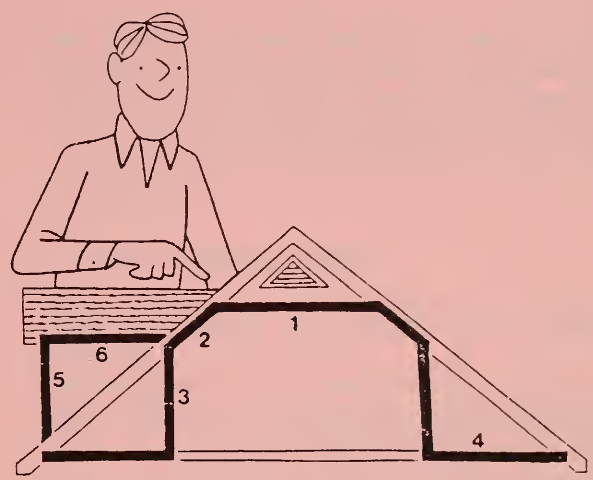
Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Where To Insulate

The diagram shows where insulation goes. The numbers on it are keyed to the list below:

1. Ceilings with cold spaces above.
2. Exterior walls. The short walls of a split-level house (2A) should not be neglected. Walls between living space and unheated garages or storage rooms should be insulated, too. Walls that are enclosed on both sides can be insulated only by an insulation contractor.
3. Floors above cold spaces — vented crawl spaces, garages, open porches, and any portion of a floor in a room that is cantilevered beyond the wall below (3A).





Insulate attic living space as indicated in the diagram above:

1. Between "collar beams."
2. Between sloping rafters. Be sure to leave an air space for ventilation between the insulation and the roof deck (select insulation thickness accordingly).
3. Between the studs of "knee walls."
4. Between the joists of the floor outside the living space.
5. Dormer walls.
6. Dormer ceilings.

Tools To Do The Job Right

Sharp knife to cut blankets and batts. A serrated-edge kitchen knife works well.

Straight edge to cut along - a rigid metal rule or a short lenth of board.

Measuring tape if you don't use a metal rule as a straight edge.

Rake, or other tool, to push or pull blankets to the eaves edge if there isn't much headroom.

Walk boards — several pieces of ¾ inch utility-grade plywood, 12 to 16 inches wide and 4 feet long, or something similar. If you step on the top ceiling surface, your foot will plunge right through — so use walk boards.

Portable light, such as a mechanic's trouble light or a clamp-on photographic light. An extension cord, too.

Staple gun for applying wall insulation. It can be rented.

Precautions To Take

Treat electrical wiring with care. Don't try to pull it or bend it out of the way.

Even in the cleanest of homes, attics tend to be dusty. Wear old clothes.

Insulations fibers can cause temporary skin irritation, so wear work gloves and loose-fitting clothes, including a long-sleeved shirt.

Be wary of nails that stick through the roof sheathing above your head.

Don't smoke in the attic.

Provide good lighting

Don't place insulation near electrical light fixtures, a furnace, or similar heat-producing device. Extreme heat, even without a flame, can ignite some insulation.

ENERGY CONSERVATION BULLETIN 1.2A.1
How To Insulate (Attic)

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Three different types of insulation are appropriate for attic work:

BATT TYPE: slabs of lightweight glass or mineral fibre. Available with or without a vapor barrier on one side.

BLANKET TYPE: identical to batt type, except sold in continuous rolls.

LOOSE FILL: a variety of loose materials made up of small particles ranging in texture from granular to fluffy.

—BATT/BLANKET TYPES:

- in most circumstances these types are more easily handled and applied than loose fill.
- they are pre-manufactured, with the quality assured.
- they are the most suitable insulation materials for vertical surfaces in the attic (though rigid insulation could also be used)
  they can be installed with an attached vapor barrier if desired
- the cost per unit of R-value is generally higher than for loose fill.
- the choice between batt and blanket types will depend upon the particular job to be done. Blanket insulation is often more awkward to install.

—LOOSE FILL TYPES:

- best suited for non-standard or irregular joist spacing or when space between joists has many obstructions. Gets into small areas.
- loose fill generally costs less per unit of R-value than batts or blankets.
- if a vapor barrier is desired, it must be applied separately from the insulation.

—IF USING BATT/BLANKET TYPE:

- the differences between glass and mineral fiber are are not large. Glass fiber is easier to handle and may fill the space more effectively than some mineral fiber batts. On the other hand, mineral fiber tends to have a higher R-value per inch. Make your choice accordingly.

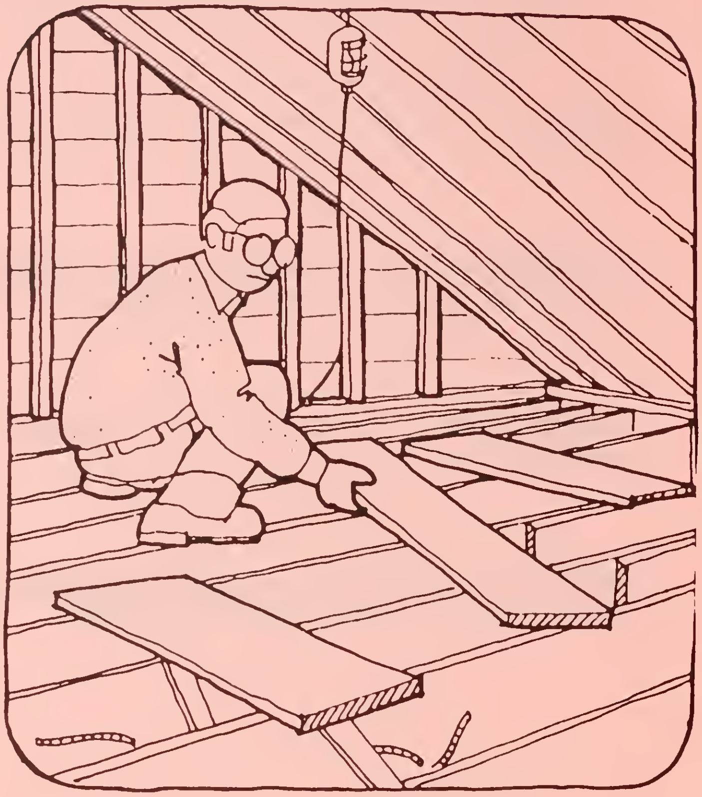
—IF USING LOOSE FILL TYPE:

- glass and mineral fiber are fire and moisture resistant.
- cellulose fiber has a higher insulation value for a given thickness. It is made from recycled newsprint, and as such reduces waste in other areas. It is less prone to undesirable settling than other loose fill insulations. It is treated with a fire retardant, though some formulations may not last the lifetime of the insulation. The insulation does absorb water, and therefore should not be used where water can come in direct contact with the insulation.
- loose polystyrene has the best moisture resistance of the loose fills, but can increase the fire hazard. The shredded variety will be substantially less expensive than the beads.
- Vermiculite is quite expensive per unit of R-value, relative to other types. Even the water resistant variety will absorb moisture and possibly cause problems. It does have a very high fire resistance.
- Wood shavings are suitable for ceiling use only. If locally produced and treated to give fire resistance, shavings may represent good value. The same moisture considerations apply as with cellulose fibre.
- Wood wool may be used if available locally at competitive prices. Purchase it only if it has been treated with fire retardant. If moisture is likely to be a problem, use a moisture resistant insulation.
- If you are using loose fill insulation and plan to pour it into place, make sure you purchase the "pouring" type. The "blowing" type must be blown in by a special machine, unless stated differently by the manufacturer.

Choose the insulating material best for your job. If 2 or more materials seem appropriate, decide on the basis of price! Finally, decide what R-value you are going to install (if you haven't already).

Installing Attic Insulation

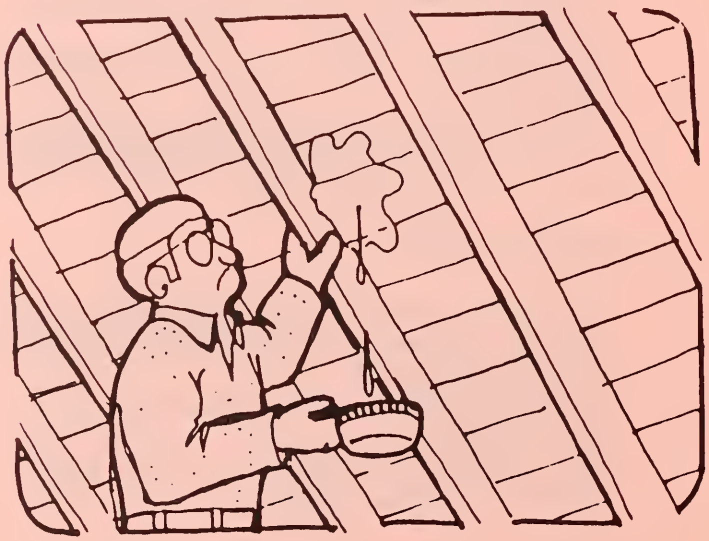
If your attic is large enough to work in, but there is no access hole, you should probably cut one. This will allow you to do a good job at a reasonable cost. Cut the hole in an out of the way place (such as a cupboard), making sure that no structural supports are damaged.



1) Install temporary lighting and flooring. Keep insulation wrapped until you are ready to install it. If possible, unwrap batts and blankets in the attic, since they expand and become less manageable after opening.

Tools Required

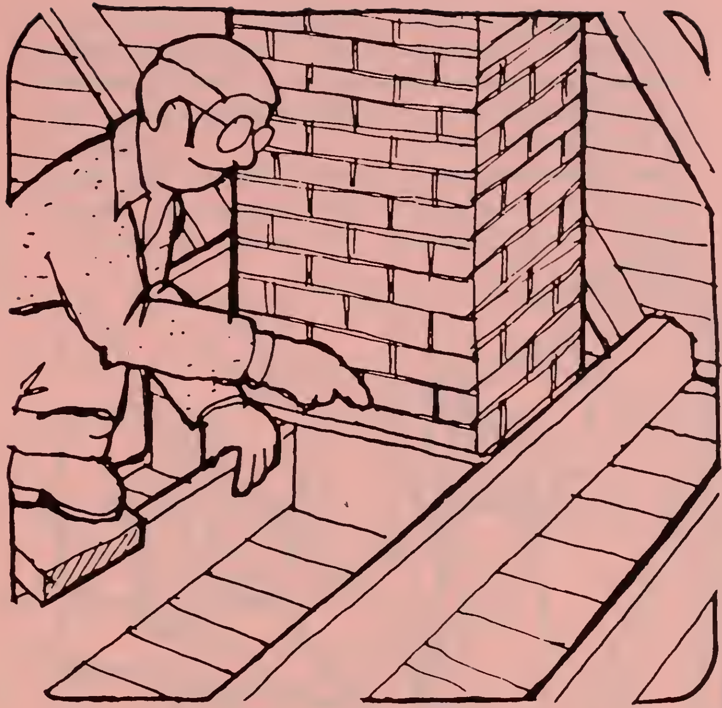
—temporary lighting
—temporary flooring
—if you are installing a vapour barrier,
—a roll of good quality tape, compatible with the barrier you are using
—heavy duty staple gun (you should be able to rent this) and staples; alternatively a hammer and tacks
— heavy duty shears or linoleum knife
— rake or some tool to manoeuvre insulation into place around eaves when there isn't enough headroom.



2) Check for leaks in the roof — wetness or water stains. If there are any, repair them first.

Safety

1) Provide good lighting
2) Lay boards down over the tops of the joists or trusses to form a walkway (the ceiling below won't support your weight).
3) If roofing nails protrude through the roof above, be careful! You may want to wear a hard hat.
4) If you use glass or mineral fibre, wear gloves and a breathing mask, and keep the material wrapped until your are ready to put it in place.
5) Locate all electrical wiring in your attic, and then avoid all unnecessary contact with it.



3) Check also for any obvious air leaks into the attic from inside the house. Seal all places where pipes or wires (careful!) penetrate the attic floor. Similarly, seal around ceiling light fixtures, the tops of inside walls, chimneys, hatches, and so on. Caulking, oakum, and polyethylene scraps are recommended, though polyethylene should be kept away from any direct source of heat such as a light fixture. It is especially important to ensure that no exhaust fans discharge into the attic. If they discharge to the outside, make sure the exhaust vent is not directly below the eave vents.
4) If you have done your best to cut down air leakage into the attic, and moisture problems persist, you may have to install additional ventilation. In most cases, this should not be necessary.

5) EXISTING INSULATION: make sure it is dry and in reasonable condition. Many old houses will have unusual insulation types, such as seaweed, wood shavings, or old newspapers. Whatever the kind, if it is wet, remove it altogether. Before adding new insulation, locate and eliminate the source of moisture.

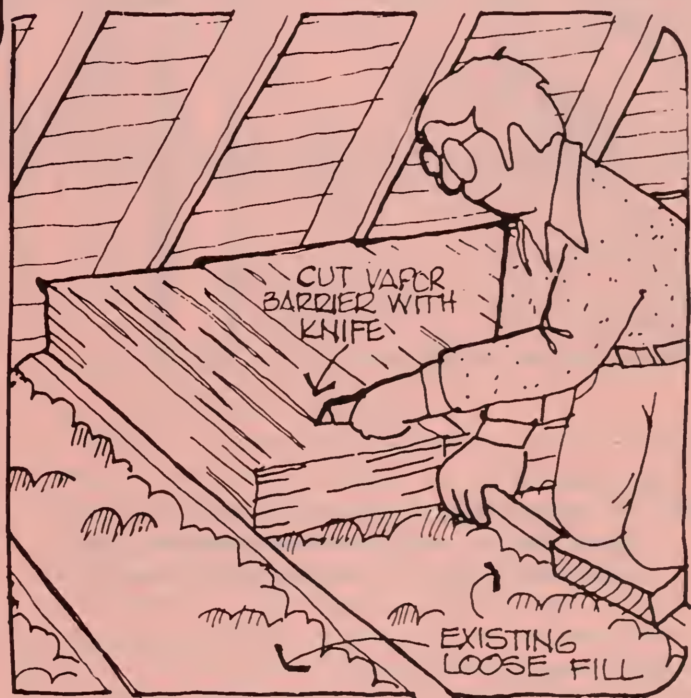
6) VAPOR BARRIER

— If there is an existing vapor barrier, your job will be easy. Patch any obvious breaks in it, then proceed with the insulation. If you are using batts, try to get the "friction fit" type with no attached barrier. If you can only get the built-in vapor barrier type, then place the barrier on the upper side and slash it with a knife to allow air to pass.

— If there is no existing vapor barrier and no existing insulation, install a barrier as outlined below.

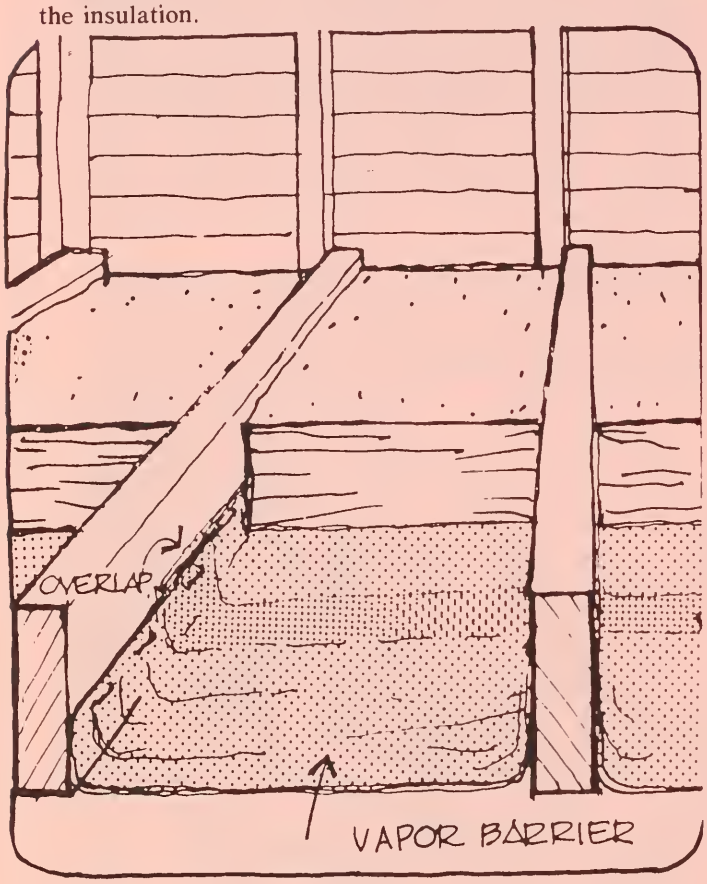
— In a case where there is no existing vapor barrier, but insulation is present, a barrier should never be placed on top of the existing insulation. Under some circumstances, it may be necessary to lift the insulation and put a barrier under it. However, if you have been having no moisture problems to date, if you are conscientious in sealing air leaks through the ceiling, and if humidity levels in the house are reasonable — then no problems should result from adding more insulation without any vapor barrier. Additional moisture protection can be achieved by painting the lower side of the ceiling with two coats of oil-based paint or a single coat of spar varnish.

If you do not add a barrier, it is probably worthwhile to check the attic after a cold snap in January or Febraury. Some frost buildup is to be expected, but if it is particularly heavy, you should work harder at sealing air leaks into the attic!



7) INSTALLATION OF VAPOUR BARRIER (if required)

— The polyethylene should be cut into long strips about 4 inches wider than the joist spaces.
— Being careful to get right to the edges, the sheet should be laid down as shown. It should be stapled to the extent necessary to keep it from moving during installation of the insulation.



NOTE: The polyethylene should not be slung over the joists, as this could trap moisture between the plastic and the wood - an undesirable situation!

— Seams should be overlapped about 6" and, for optimal coverage, taped as well.
— Any obstruction in the attic, such as wooden braces or electrical wires (careful!) will require cuts in the barrier. Seal these as much as possible with tape and small pieces of polyethylene.

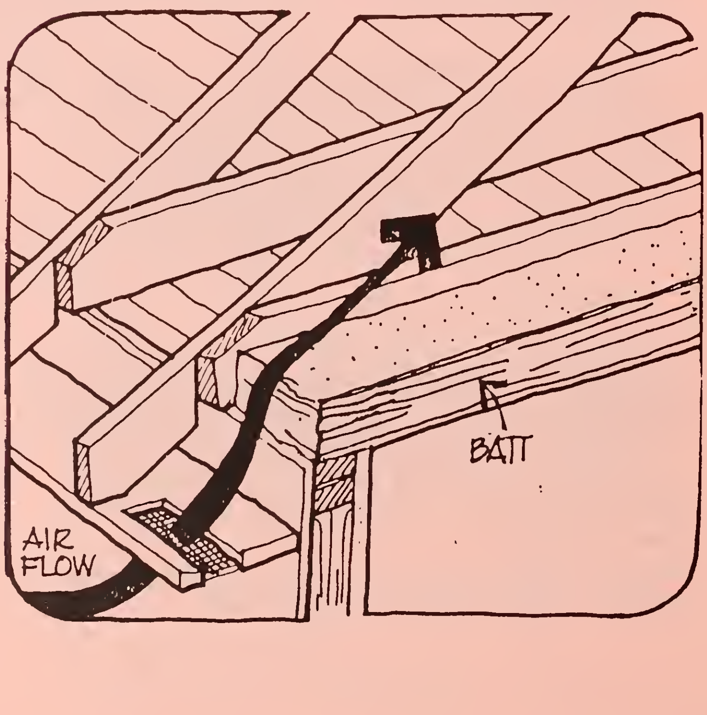
8) INSTALLATION OF THE INSULATION

Depending upon the type of insulation you are using, you should follow the directions given in EITHER A OR B.

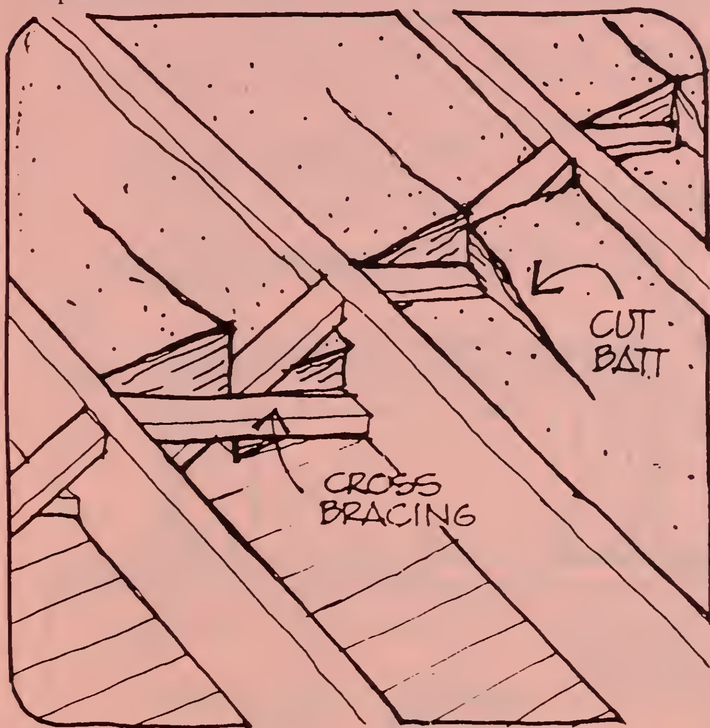
A: BLANKET OR BATT INSTALLATION

— blanket type insulation is applied in basically the same way as the batt type to be described below. It may be precut with scissors, or cut on the spot. Start at one end of the attic, and unroll!
— batt type insulation is simply pressed into place between the floor joists. If you purchased the correct width, it will fit snugly. No stapling in place is necessary.

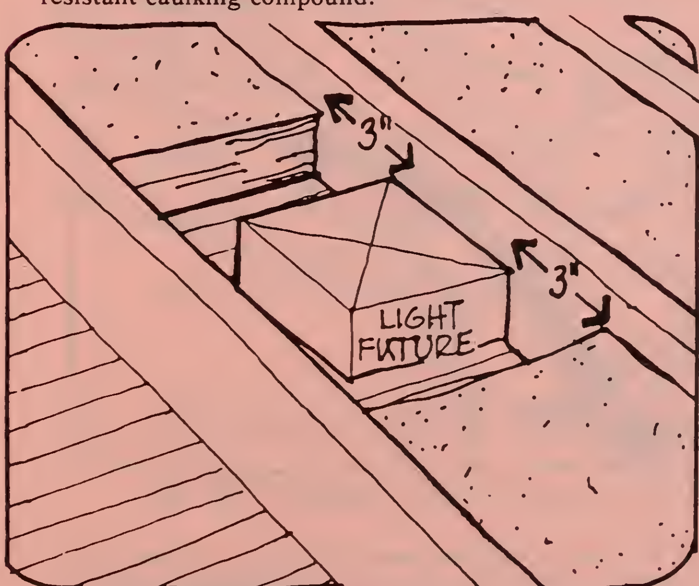
— if using a bat with attached vapor barrier, the barrier should be on the side towards the living area. Any tears in the barrier should be sealed with tape. Do not put this kind of insulation on top of existing insulation.
— batts should not block the venting, but otherwise should extend as far as possible towards the eave.



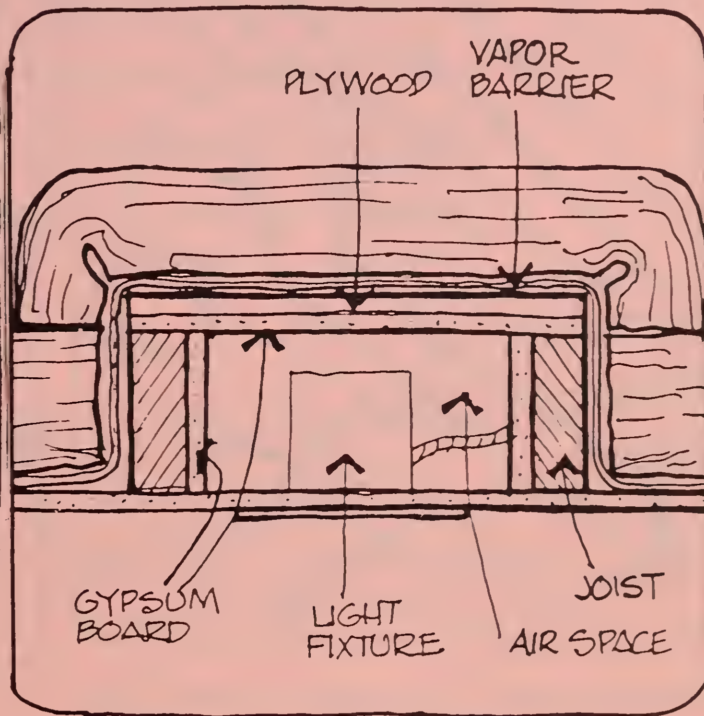
— butt the ends of different batts together as tightly as possible.
— insulate tightly around cross bracing using diagonal cutting as illustrated. If possible, avoid cutting the vapor barrier.



— do not insulate any closer than 3'' from any recessed light fixtures or other heat sources such as an exhaust fan motor. Heat build up could lead to a fire hazard. On the other hand, the fixture will continue to be a major heat loss and possibly a moisture problem. The best solution is to eliminate the fixture if at all possible. If not, at least caulk any obvious openings with a heat resistant caulking compound.



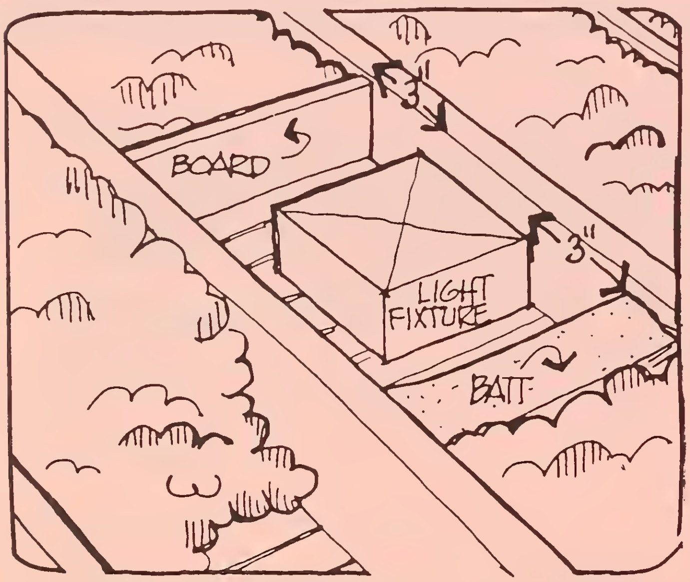
If the fixture does not touch any of the joists, and if any heat build-up could escape readily into the room below, you might consider building a box of plywood around the fixture. Line the inside of the box on all surfaces with gypsum board, leaving an air space all around the fixture. The box should then be insulated normally. **Only undertake such a project if you are certain no problems will arise.**



— insulate around the chimney with non-combustible materials. Unfaced glass or mineral fibre is fine.
— if you are installing more than a single layer of insulation and the first fills the joist space entirely, lay the second at right angles to the first. The second of course, should not have a vapor barrier.
— finally, don't forget to insulate and weatherstrip the hatch into your attic!

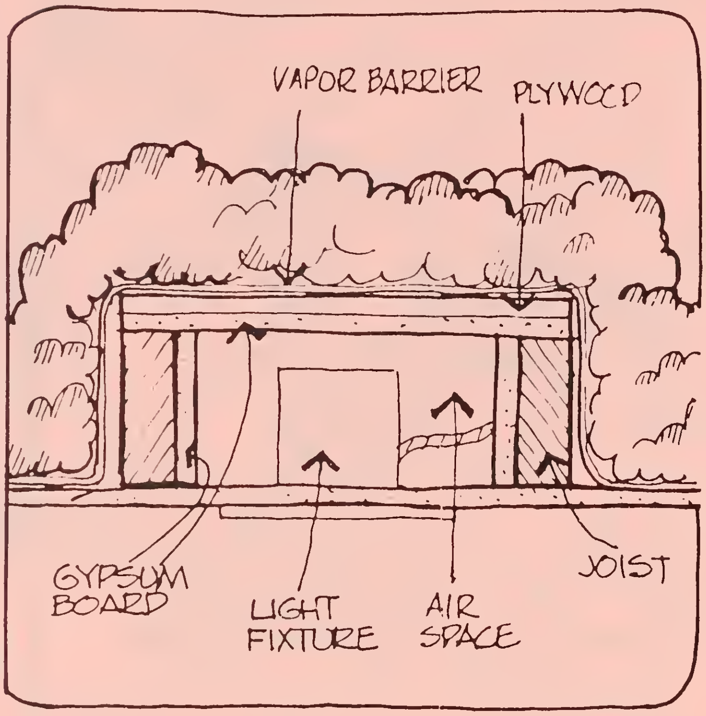
B: LOOSE FILL INSULATION

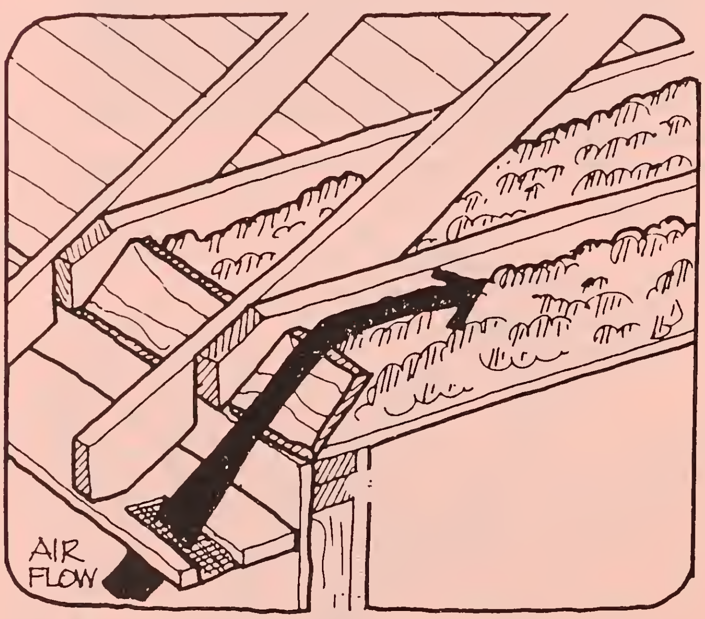
— loose fill insulation is simply poured in on top of the vapor barrier. It is levelled off with a board or garden rake, as illustrated. If you are adding insulation to a depth greater than the height of the joists, the extra thickness makes levelling a bit difficult — but it will be worth it.



— pour it to fill all nooks and crannies, but **do not cover recessed light fixtures or exhaust fan motors.** Heat buildup could become a problem. The insulation should be kept away from the fixture, either by using a batt or some wood framing as shown. The fixture will continue to be a major heat loss and possibly a moisture problem. The best solution is to eliminate the fixture if at all possible. If not, at least caulk any obvious openings with a heat resistant caulking compound.

If the fixture does not touch any of the joists, and if any heat build-up could escape readily into the room below, you might consider building a box of plywood around the fixture. Line the inside of the box on all surfaces with gypsum board, leaving an air space all around the fixture. The box should then be insulated normally. **Only undertake such a project if you are certain no promblems will arise.**





— at the eaves, caution must be taken to keep the insulation from blocking the ventilation and/or disappearing into the eave space. Batt insulation or a wood baffle may be used.

RECOMMENDATIONS OF REA

. . . The energy conservation policy adopted by the board of directors should require, (1) a commitment to an aggressive program to conserve electric energy in the headquarters and other co-op facilities, (2) a commitment to an aggressive program to help consumers conserve and use energy efficiently, and (3) the necessary authority to develop a plan and budget to accomplish the objectives, and to develop appropriate reports to assess results.

. . . Identify opportunities to promote more efficient use of energy and set priorities for assistance to consumers by analysis of consumer uses of energy, billing records, high bill complaints, delinquent accounts, etc.

. . . Provide trained personnel to provide—on a "one-to-one" basis—technical assistance, advice and information for members of the cooperative for the efficient use of electric energy in the home, farm, business or public building, including estimates of the cost of insulation or other expenditure necessary to achieve energy conservation and the estimated savings in electricity costs resulting from any investment or conservation practice.

. . . Encourage and promote insulation standards as recently adopted by the Farmers Home Administration.

. . . Cooperate with consumers who want to install alternative energy systems for their own use, such as windmills, biomass facilities, and solar systems for cooling, space and water heating, and wood burning systems.

. . . Seek assistance and where appropriate, coordinate conservation efforts with NRECA, statewides, other electric cooperatives, power suppliers, state energy offices, Farmers Home Administration, and other organizations with programs or resources that can help the cooperative with its conservation objectives.

. . . Make arrangements with the Farmers Home Administration, community action agencies, local banks, etc., to finance conservation measures for those consumers in need of such assistance.

. . . Work with local contractors and suppliers in helping assure that consumers received quality workmanship and proper conservation materials.

. . . Work with local building contractors to help assure the construction of energy efficient homes.

. . . In advising electric cooperative members about electric heating or air conditioning, that the cooperative provide estimates of

the longer-range cost of electric service; for example, an estimate of the increased cost of electricity for the next five or ten years.

GUIDELINES FOR DEVELOPING AN ENERGY CONSERVATION PLAN AND BUDGET

Because of the differences in rural electric systems caused by geography, size, financial condition and other variables, energy conservation actions will vary from system to system. However, the following items can serve as a checklist in developing a plan of action.

I. General Outline

1. Include a statement of objectives and proposed actions to be taken in line with predetermined needs and projections.

2. Indicate the kind and amount of resources required.

3. Indicate how the resources will be obtained, i.e., hire additional personnel, by reassignment, or by arrangement with other cooperatives or associated organizations.

4. Provide a procedure for measuring and reporting accomplishments.

II. Consumer Education

1. Make available printed material to consumers.

2. Present displays in office, community, and state and regional events.

3. Hold informational meetings with consumers.

4. Use newspapers, radio, and local TV.

5. Coordinate actions with the energy educational programs of the statewide, G&T, and NRECA.

6. Coordinate programs with local and state extension service, state energy office, and other organizations helping the families in the co-op service area to conserve energy.

III. In-Home Conservation

1. Involvement of employees in helping to use energy wisely.

2. Weatherize co-op-owned structures.

3. Examine and if possible modify heating and cooling systems.

4. Use the most energy efficient lighting sources.

5. Utilize building space in the most energy efficient measure.

IV. Technical Services to the Consumer

1. Offer to assist consumer in determining insulation and other weatherization needs, costs and possible pay-back period.

2. Offer to assist consumer in arranging to have suggested measures installed.

3. Offer to assist in arranging financing if necessary.

4. Advise on appliance and equipment efficiency and suggested usage patterns.

GUIDE FOR CALCULATIONS

OF

ELECTRIC SPACE HEATING AND COOLING

Tennessee Valley Authority
Power Marketing Division

Revised March 1974

TABLE OF CONTENTS

GUIDE FOR CALCULATIONS OF ELECTRIC SPACE HEATING AND COOLING

GENERAL DISCUSSION

Electric space heating is now well past the experimental stage. It has become a conventional method of heating, not only for residences but for commercial and industrial buildings as well. It is gaining in popularity and will be demanded by the public in the future. Accordingly, both the seller and installer of electric space heating equipment should understand the fundamentals of calculating heating requirements and the correct application of the equipment to insure satisfaction to both the user and the electric power distributor.

It must be stressed that satisfaction is contingent upon a number of factors, all of which should be considered before an installation is made. Accordingly, there follows a brief discussion on some of these.

Insulation

Engineering tests have shown that often as much as 50% of the heat generated for heating the house leaks outdoors. It is just as important from the standpoint of economy to insulate the house adequately in order to hold the heat in as it is to insulate the electric refrigerator to hold the heat out.

There are a great many manufacturers of suitable insulation and usually prices are reasonable for insulating sidewalls and ceilings, particularly when the insulation is applied during construction of the house.

Generally, it is recommended that 6″ of mineral wool or its equivalent be installed above ceiling areas, 3½″ in outside walls and 2″ beneath floors. This program can reduce the heat loss more than 50%.

Figure 2 in rear of the manual illustrates the effectiveness of insulation in reducing heat loss.

Weather Stripping

In order to minimize heat loss due to infiltration of cold air from the outside, it is important that weather stripping be installed on windows and outside doors. Not only does this reduce the heat loss by approximately 12% but provides greater comfort by helping to eliminate floor drafts and cold wall areas.

Double Glass or Storm Sash

The heat loss can be further reduced by using double glass windows or storm sash. In justifying the saving to be realized, the original expense should be considered, however, and each case treated individually.

Fireplace Dampers

All open fireplaces should be equipped with well-fitting dampers, which should be closed except when fires are maintained; otherwise, considerable heat is lost through the chimney, resulting in higher operating costs. The use of these dampers will also minimize uncomfortable floor drafts.

Window Sweating

In the winter condensation collects on interior surfaces of windows, cold closet walls, and on the interior surface of poorly insulated sidewalls. The extent of this condensation depends on the surface temperature of the material and the dew point temperature of the air in contact with these areas.

Water vapor is present in all air, and it has the same properties that it would have if the air were not present. When the vapor in a space is cooled down either by contact with cold surfaces, or otherwise, to a temperature below its dew point temperature, some of the vapor will be condensed and form either free water or frost, depending on the temperature.

For any set of temperature and humidity conditions there is a definite relation between the possibility of condensation and insulation of the area in question. For example, a much colder temperature would be required to cause condensation upon the inner surface of a well-insulated wall than one without insulation. By the same token a window equipped with double glass or storm sash can withstand much colder outside temperatures without condensation or "sweating" than with conventional single glass.

Generally when a well-constructed and adequately insulated home is heated electrically, the inside relative humidity during the heating season averages approximately 40%. By referring to the Condensation Chart included in this manual, it can be seen that a window of single glass will begin sweating or condensing moisture from the air when temperature difference between inside and outside is approximately 36°. By comparisons it may be noted that inside relative humidity could be as high as 50% and the temperature difference between inside and outside temperatures 70° F. before condensation would occur with windows of double glass construction.

The use of storm windows is probably the most economical method for minimizing window

sweating. Storm windows will also reduce the heat loss through window areas by approximately 50%, thus effecting a considerable saving in operating cost of the heating system.

In modern homes, which usually have home laundry equipment as well as automatic dishwashers, it is recommended that an exhaust fan be used in the kitchen and bathrooms. If so desired, their operation may be automatically controlled by humidistats.

TYPES OF ELECTRIC HEATING

Unit Heaters

The term, unit heater, may be applied to any heater which is complete in itself whether of the wall-rcessed type, the portable plug-in type, or the wall- or ceiling-mounted type. Usually, one or more unit heaters are used in each room or space to be heated, and it is recommended that each heater be controlled by a thermostat.

Some heaters are equipped with fans for forced-air distribution, while others of the radiant-convection type depend on gravity circulation. Both types have individual advantages and both operate at the same degree of efficiency.

When unit room heaters are used they should be placed on outside walls, and preferably, beneath windows. The exact location should be determined so as to provide heat where needed most when the room is occupied. Sometimes rooms, such as bathrooms, kitchens, and bedrooms do not have available space for heaters on outside walls. In such cases, individual judgment must be exercised to determine the exact heater location.

In commercial installations ceiling-suspended, forced-air heaters are often used. Generally, these heaters are located adjacent to outside walls, blowing toward the inside of the building.

Baseboard Heaters

Baseboard heaters are designed to occupy a minimum of space at the junction of the floor and outside wall, thus leaving more space for the arrangement of furniture. They are manufactured in various lengths from 2 feet to 12 feet and with wattage densities from 100 watts to 400 watts a lineal foot. Individual lengths are normally fastened together, end to end, and corner fittings are available to permit following the configuration of the outside wall.

For residential space heating it is generally recommended that the wattage density not exceed 250 watts a lineal foot and, preferably, 200 watts a lineal foot. By using heater units of low densities, "smudging" of walls and draperies is minimized, and there is less tendency to override the thermostat setting.

All baseboard heaters should contain continuous thermal cutouts to shut off the current in case of any accidental obstruction to air flow through the heater. Some of the advantages claimed for baseboard heaters are:

1. Convected air currents rise along the outside wall, providing less cold drafts in the room.
2. Windows have less condensation.
3. Floors are warmer.
4. Furniture location is not limited.

Heating Cable

Heating cable is used most extensively in ceilings and may be either embedded in plaster or sandwiched between two layers of gypsum board. Basically, the cable is thermoplastic- insulated copper-alloy wire with an electrical rating of 2¾ watts a lineal foot. The spacing between runs of the cable should not be less than 1½ inches. Installation should conform to provisions as outlined in Article 424 of the *National Electrical Code*.

Heating cable is invisible, takes up no room space, does not interfere with furniture arrangement, and provides adequate distribution of heat. However, in rooms with large glass areas, it may have to be supplemented with additional heating capacity, such as baseboard. in order to counteract excessive downdrafts from the cold glass surfaces and to provide the desired heating requirements.

Cable is also effective in concrete floors and is used quite successfully for heating warehouses. Spacing should be designed so that floor surface will not exceed 85°F.

Wall Heaters

These heaters, as the name implies, are designed for surface or recessed mounting in the walls. They may be of the gravity-circulation type or may include a fan for forced convection. They are available from 1 kw to 14 kw but for residential use, if a room needs more than 3 kw of heating capacity, it is generally recommended that two or more heaters be used.

The larger sizes are usually marketed in a heavy cabinet for use in schools, offices, or other commercial applications. These are available from most manufacturers for 3-phase operation at 208, 240, 277, or 480 volts.

This type of heater was among the first to make its appearance on the electric space heating market and has continued to hold its popularity. Like baseboard, it is generally installed on an outside wall and preferably beneath the window area.

Portable Heaters

Portable heaters are similar to wall heaters except that they are free standing and can be moved from one location to another. They are supplied with cable and plug for connecting to a fixed receptacle. They vary in capacity

from $1\frac{1}{2}$ kw to 5 kw and usually are equipped with built-in thermostat.

Radiant Panels

This type of heating equipment is usually made of fiber sheets with resistance cable embedded inside. Physical sizes range from two by four feet to four by twelve feet, with electrical capacities up to approximately 15 watts/sq. ft. These panels are normally used in the ceiling and can be used in new construction as well as older, existing buildings.

Infrared Heaters

High temperature radiant heating by infrared rays is used quite extensively now for heating people without heating the air. Typical applications include heating workmen at isolated work stations, partially sheltered outdoor waiting stations, loading docks, and beneath marquees of theaters and store entrances.

The metal sheathed and quartz tube heater elements normally operate between 1200° and 1800° F., and the actual electrical capacity is usually 40 to 50 watts an inch of length.

The fixtures are usually mounted not farther than 10 feet from the intended target at an angle of approximately 45° above the horizontal. Spot heating generally requires from 1 to $1\frac{1}{2}$ watts a square foot for each degree rise in comfort level desired.

Since we are not heating the air with infrared heaters, the use of a conventional thermostat is "out of order" for controlling their operations. They can be controlled by a simple "on-off" manually operated switch or by a percentage timer. The timer will alternately energize and deenergize the heater circuit since the "on" time is adjustable from 0 to 100% by turning the knob on a graduated scale.

Central Furnaces

Central furnaces have been in use many years, though within recent years a number of refinements have been incorporated. An electric furnace is comprised of a blast coil of capacity to match the heating requirement of the house, a blower, and a filter section.

They are made to be installed horizontally or vertically with either upflow or downflow of air supply. They may be installed in closets, utility rooms, basements, crawl spaces, or attics.

The heating coil is usually divided into several "banks" or circuits, ordinarily of not more than 5 kw each. The "banks" are controlled thermostatically to match the immediate heating requirements of the house.

The blower is designed to circulate a minimum of 60 cfm per kw of total heating capacity, and is usually the centrifugal type to minimize the noise level.

The filter section may be equipped with either the permanent, recleanable type; the throw-away type filter; or the electrostatic filter, which removes about 95% of all dust, lint, smoke, or other minute particles in the circulated air.

The central furnace has the following inherent advantages:

1. It provides positive circulation of air throughout the house.
2. It can provide filtered and conditioned "make-up" air in desired quantities.
3. Germicidal lamps or other germ killing devices may be incorporated in the discharge plenum.

The growing demand for summer cooling will influence the extent of installations of central systems since these provide the means of adding air conditioning at a later date.

Heat Pumps

The heat pump is now a recognized year-round air conditioning device well beyond the experimental stage. A large number of reputable manufacturers in the refrigeration business are now marketing heat pumps.

A mechanical refrigeration compressor, a fan-coil unit, and auxiliary equipment comprise a heat pump. They are available in self-contained packaged units or in "split" systems, where the compressor unit may be installed outdoors and the air-handling unit indoors. The "split" system would, of course, result in a minimum noise level inside the house.

It can well be understood that as the outside temperature decreases, the output of the heat pump in Btuh also decreases, whereas the heat requirement of the building increases. The point at which the heat pump, without auxiliary heat, can exactly provide the heat requirements of the building is called the "balance point." This balance point will vary with each installation and must be calculated after the heat loss of the building is established and the heat pump is selected.

Normally the heat pump is sized according to the cooling requirements of the building but this may result in too high a balance point. Preferably, the balance point should not exceed 30° F. outside temperature and in no case be higher than 35° F.

Heat requirements of the building for temperatures below the determined balance point are provided by auxiliary electric resistance heat, installed as air blast heaters or grids in the discharge plenum of the air-handling or fan-coil unit.

Any modern new building for which air conditioning is contemplated is a logical prospect for a heat pump, and several distinct advantages are suggested.

1. Considerable saving in heating cost, as compared to resistance-type electric heating, may be realized.
2. It provides all of the advantages of a central system, as already mentioned.
3. It provides automatic changeover from heating to cooling and vice versa.

Table I shows typical performance data of heat pumps and a suggested method for calculating energy usage for heating and cooling requirements.

It is important to know the advantages of all types of electric heating equipment and be competent to make the proper application.

ELECTRIC SPACE HEATING CALCULATIONS

In estimating capacities of electric heating equipment required to maintain desired temperatures in various buildings, it is necessary to consider the following factors:

1. Area of exposed glass (windows) and outside doors
2. Area and construction of outside walls
3. Area and construction of inside walls, and temperature of adjacent rooms
4. Area and construction of floor and temperature conditions beneath floor
5. Area and construction of ceiling, and temperature conditions above ceiling
6. Volume of air in space to be heated and number of natural air changes to be expected per hour
7. Inside temperature to be maintained and basic outside design temperature

It is suggested that a survey similar to the one on page 7 be completed before the heating load is computed. A sketch of the building should be made, showing all pertinent dimensions and locations of doors and windows.

Table III shows heat loss coefficients in watt-hour loss per square foot per degree Fahrenheit temperature difference (TD) through various types of construction, as well as the "R" factor. In the event a type of construction is encountered for which a heat loss coefficient is not listed, use the factor for the type of construction most nearly the same.

There are no hard and fast rules for selecting the design outdoor weather conditions to be used for a given locality; the problem is to some extent a matter of judgment and experience. According to the *ASHRAE Guide*, the outside design temperature is seldom taken as the lowest temperature, or even the lowest daily mean temperature ever recorded in a given locality. Such temperatures are rarely repeated in successive years.

Outside design temperatures for space heating will vary from 35° F. in central Florida to —40° F. in northern Montana.

Table IV shows degree days for the major cities. Figure 1 shows the same information on a map.

Generally, residential and office applications are computed on the basis of maintaining 70° F. inside temperature when the outside is at design temperature. On the other hand, in applications where occupants may be engaged in physical activity lower inside temperatures may be desirable. For example, 60° F. inside temperature might be satisfactory for a machine shop or a factory.

As a general rule the air space in a basement or under floors with solid foundation walls, which is unventilated during the heating season, may be assumed to reach a minimum temperature of 35° F. In case of concrete floors directly on the ground, the minimum ground temperature beneath the concrete may be considered 50° F.

When insulation is used above the ceiling area of a building the attic should be ventilated in order to avoid condensation with resultant inefficiency of the insulation and deterioration of the framing of the building. Thus, with insulated ceilings, attic temperatures should be considered equal to outside design temperature when calculating heating requirements.

It is necessary in all cases when calculating heating requirements to make allowance for air changes in the space to be heated, such changes being due to infiltration through cracks around doors and windows and other structural crevices as well as from natural opening of doors or windows. The type of occupancy will naturally determine the extent of this natural infiltration, but it has been found that less natural air change may be expected with electric space heating than with combustion-fired heating equipment. For most purposes the number of air changes may be assumed as follows:

Residences ----- ½ air change per hour
Retail Stores --- 1 air change per hour

To compute the wattage capacity necessary to compensate for heat loss due to air change, use the factor of .0053 watts per cubic foot per degree F. temperature difference. For example:

Volume (cu. ft.) × N (number changes per hour) × TD (temperature difference between inside and outside design temperatures) × .0053 = watts

Separate calculations are necessary for computing wattage required to counteract losses through wall, glass, door, ceiling and floor areas. The following formula may be used for calculating wattage requirements:

Area (sq. ft.) × TD (inside °F. — outside °F.) × "W" factor = Watts

Thus, the total wattage capacity required to heat any space is the sum of the wattage capacities necessary to compensate for *all* the heat losses as computed according to the above formula.

ESTIMATING KWH CONSUMPTION

The "degree day" is the accepted designation of temperature deficiency, being the net difference between average outside temperature over a 24-hour period and a base temperature of 65°. For example, assuming an average daily temperature of 45° there would be 20 degree days for that particular day.

The number of degree days in a normal heating season in any area will influence the energy usage of electric space heating, so we can say that kwh usage is proportionate to the number of annual degree days for that particular area.

A degree day map, Figure 1, is included in the rear of the manual, showing number of degree days within limits as recorded by the United States Weather Bureau. They are averages obtained from . . . (Cont. on p. 8)

Name ____________________ Address ____________________

		Dimensions	Gross Area	Net Area	U Fac. x TD Multiplier	Heat Loss Watts/Hr.
Living Room	Windows				x	
	Doors				x	
	Outside Wall				x	
	Ceiling				x	
	Floor				x	
	Air Change Cu ft/Hr				x	
					x	
	Total					
Dining Room	Windows				x	
	Doors				x	
	Outside Wall				x	
	Ceiling				x	
	Floor				x	
	Air Change Cu ft/Hr				x	
					x	
	Total					
Kitchen	Windows				x	
	Doors				x	
	Outside Wall				x	
	Ceiling				x	
	Floor				x	
	Air Change Cu ft/Hr				x	
					x	
	Total					
Bath #1	Windows				x	
	Doors				x	
	Outside Wall				x	
	Ceiling				x	
	Floor				x	
	Air Change Cu ft/Hr				x	
					x	
	Total					

		Dimensions	Gross Area	Net Area	U Fac. x TD Multiplier	Heat Loss Watts/Hr.
Bedroom #1	Windows				x	
	Doors				x	
	Outside Wall				x	
	Ceiling				x	
	Floor				x	
	Air Change Cu ft/Hr				x	
					x	
	Total					
Bedroom #2	Windows				x	
	Doors				x	
	Outside Wall				x	
	Ceiling				x	
	Floor				x	
	Air Change Cu ft/Hr				x	
					x	
	Total					
Bedroom #3	Windows				x	
	Doors				x	
	Outside Wall				x	
	Ceiling				x	
	Floor				x	
	Air Change Cu ft/Hr				x	
					x	
	Total					
Family Room	Windows				x	
	Doors				x	
	Outside Wall				x	
	Ceiling				x	
	Floor				x	
	Air Change Cu ft/Hr				x	
					x	
	Total					

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CALCULATION SHEET FOR ELECTRIC HOUSE HEATING

Name ______________________ Address ______________________

		Dimensions	Gross Area	Net Area	U Fac. x TD Multiplier	Heat Loss Watts/Hr.			Dimensions	Gross Area	Net Area	U Fac. x TD Multiplier	Heat Loss Watts/Hr.
Living Room	Windows				x		Bedroom #1	Windows				x	
	Doors				x			Doors				x	
	Outside Wall				x			Outside Wall				x	
	Ceiling				x			Ceiling				x	
	Floor				x			Floor				x	
	Air Change Cu ft/Hr				x			Air Change Cu ft/Hr				x	
					x							x	
	Total							Total					
Dining Room	Windows				x		Bedroom #2	Windows				x	
	Doors				x			Doors				x	
	Outside Wall				x			Outside Wall				x	
	Ceiling				x			Ceiling				x	
	Floor				x			Floor				x	
	Air Change Cu ft/Hr				x			Air Change Cu ft/Hr				x	
					x							x	
	Total							Total					
Kitchen	Windows				x		Bedroom #3	Windows				x	
	Doors				x			Doors				x	
	Outside Wall				x			Outside Wall				x	
	Ceiling				x			Ceiling				x	
	Floor				x			Floor				x	
	Air Change Cu ft/Hr				x			Air Change Cu ft/Hr				x	
					x							x	
	Total							Total					
Bath #1	Windows				x		Family Room	Windows				x	
	Doors				x			Doors				x	
	Outside Wall				x			Outside Wall				x	
	Ceiling				x			Ceiling				x	
	Floor				x			Floor				x	
	Air Change Cu ft/Hr				x			Air Change Cu ft/Hr				x	
					x							x	
	Total							Total					

CALCULATION SHEET FOR ELECTRIC HOUSE HEATING

SUGGESTED SURVEY SHEET

DATA FOR ELECTRIC HEATING ESTIMATE

Power Distributor	Date
Consumer	Address

Type Building: ☐ Residence ☐ Commercial ☐ Industrial

Age of Building: ☐ New ☐ Old ☐ Remodeled

Foundation: ☐ Open ☐ Closed

Construction Data

	Type of Construction	Insulation Material	Thickness	Weather-Stripping	Storm Glass
Windows	______			______	______
Doors	______			______	______
Outside Walls	______	______	______		
Inside Walls	______	______	______		
Basement Walls	______	______	______		
Ceiling	______	______	______		
Roof	______	______	______		
Floor	______	______	______		

Space Data

Ceiling height first floor ______________. Second floor ______________________________.

SHOW FLOOR PLANS ON REVERSE SIDE OR ATTACH PLANS; GIVE SIZE OF ALL WINDOWS ON SKETCH. INDICATE ON SKETCH NORTH BY ARROW.

Type of heating system desired? ____

Is basement area to be heated? ____________________ Is garage separated by walls? ____________

Billing Information

Rate under which customer is now served ____________; present consumption ____________ kwh per mo. (avg. for 12 mos.). For commercial and industrial, indicate; Present demand __________ kw (maximum twelve months).

Customer's decision or comments ____

____

____

Other comments ____

____

____

Prepared by ________________________________ Date ____________________

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records covering many years. Exact degree day normals may be obtained for any city with an official United States Weather Bureau.

For a number of years data has been obtained from electrically heated homes, enabling us to estimate fairly accurately the kwh energy usage to be expected during a normal heating season when the heat loss of the building is known.

Accordingly, the following formula for estimating seasonal kwh has been developed:

$$\text{kwh per season} = \frac{HL \times DD \times 20}{TD}$$

HL = heat loss in kw of building
DD = annual degree days for area
TD = temperature difference between inside and outside design temperatures

While this formula is primarily intended for use in estimating energy usage for residential space heating, it is felt that it may be applicable to commercial heating if the building is maintained at a constant inside temperature.

When a central electric furnace is used, whether it be steam, hot water, or warm air, there is usually some radiation loss to be expected from pipes or ducts in the basement or exposed areas. It is suggested that seasonal kwh calculated from the formula be increased by 20% when a central furnace is contemplated.

Generally, the heating season throughout most of the Nation is comprised of seven months, beginning with October and ending with April. Naturally, some of these months have greater heating requirements than others, and accordingly, proportionately greater operating costs may be expected. The approximate monthly percentages of seasonal heating requirements might be expressed as follows:

October ---------- 4% of seasonal kwh
November -------14% of seasonal kwh
December -------22% of seasonal kwh
January --------24% of seasonal kwh
February --------20% of seasonal kwh
March ----------12% of seasonal kwh
April ----------- 4% of seasonal kwh

It would be advisable to compute these percentages more accurately for individual areas.

The following example will serve to illustrate the method of calculation necessary for residential applications:

EXAMPLE (RESIDENCE)

Assume an average size residence of six rooms with bath and a half as shown on the plan with dimensions as indicated. The information necessary for calculating the heat loss is as follows:

Ceiling height — 8 feet.

Wall construction — frame with wood siding, moisture barrier, storm sheathing, 3½″ mineral wool insulation with vapor barrier and ½″ plaster.

Ceiling construction — ½″ plaster with 6″ mineral wool under ventilated attic.

Floor construction — double wood over ventilated crawl space with 2″ blanket insulation and vapor barrier.

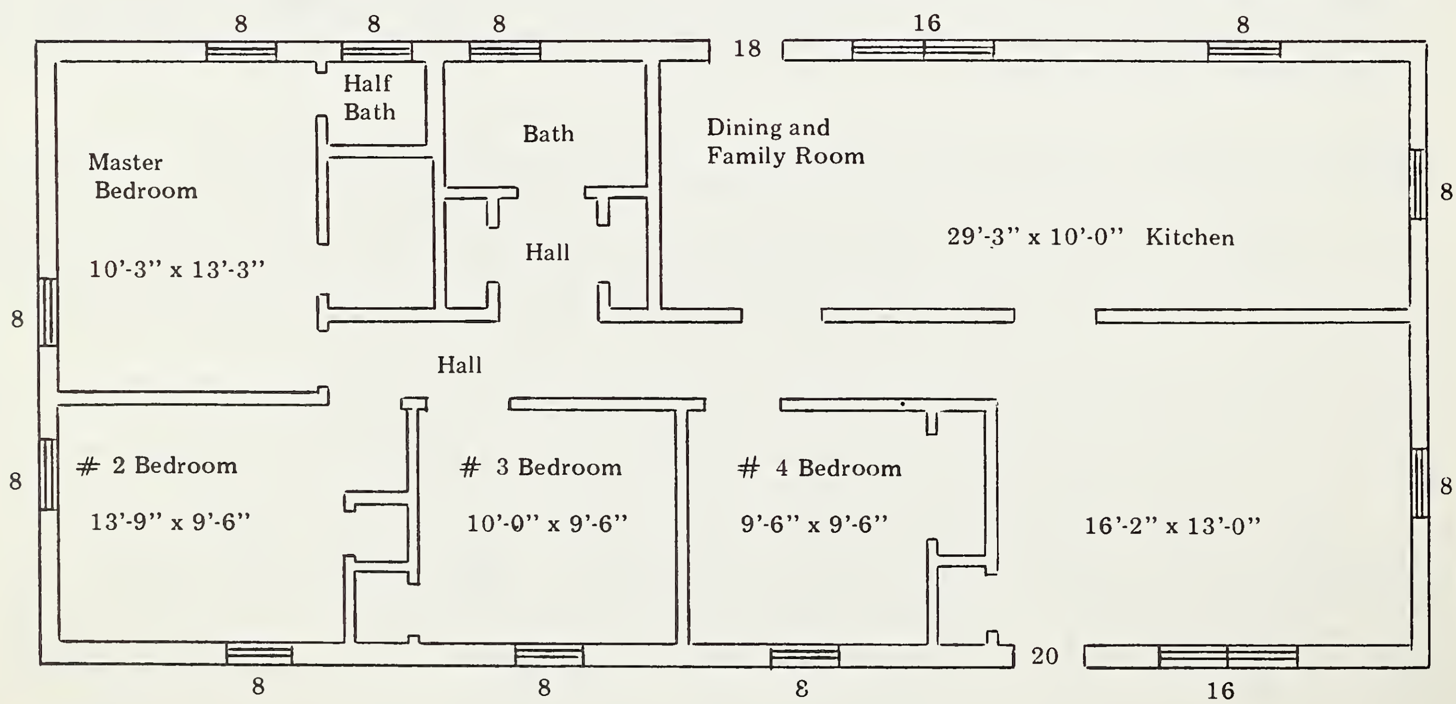
Windows — single with storm windows. Sizes as indicated.

Doors — solid wood with glass storm door.

Infiltration of outside air — assume ½ air change per hour.

Floor Area - 1,219 sq. ft.
Net Wall Area - 1,096 sq. ft.
Glass Area - 120 sq. ft.
Door Area - 38 sq. ft.
Numbers beside windows indicate sq. ft.

Scale - 1/8" = 1'-0"



Let us assume that the house is located in an area which has 3,500 average annual degree days, and that we desire to know the heat loss of each room of the house on the bases of maintaining 70°F. inside when outdoor temperature is 0° F., or on a design basis of 70° TD.

With the above information we can now go to Table III and find the heat loss coefficients for the various structural components in our sample residence. These coefficients used in the sample are noted in the tables with an asterisk.(*) These coefficients which we will use in the sample are:

	Heat Loss at 70° TD
Frame walls with 3½" insulation	1.3 watts/sq. ft.
Ceiling with 6" insulation	1.1 watts/sq. ft.
Floor with 2" insulation	1.8 watts/sq. ft.
Glass, with storm window	14.0 watts/sq. ft.
Door, solid wood with glass storm windows	7.2 watts/sq. ft.
Infiltration	.37 watts/cu. ft.

The total heat loss of the residence is 8,637 watts or 8.64 kW, as shown by the calculations on the next page.

It is impossible, of course, to select a heater to match exactly the calculated heat loss. It is suggested that the heater be selected with capacity nearest to the calculated heat loss. Accordingly, we would select heater sizes as follows:

Living Room and Hall	2.5 kW
Kitchen, Dining and Family Room	2.5 kW
Bath	1.0 kW
Master Bedroom and Half Bath	1.5 kW
Bedroom No. 2	1.0 kW
Bedroom No. 3	1.0 kW
Bedroom No. 4	1.0 kW
Total Installed Capacity	10.5 kW

COST OF OPERATION

Using the total calculated heat loss of 8,637 watts or 8.64 kW as determined by the calculations on the next page, the total seasonal kWh usage may be estimated by apply the formula:

$$\text{kwh per season} = \frac{\text{HL} \times \text{DD} \times 20}{\text{TD}}$$

$$\text{Thus kWh} = \frac{8.64 \text{ kW} \times 3500 \text{ DD} \times 20}{70^\circ \text{ F. Design Temperature Difference}}$$

$$= 8{,}640 \text{ kWh per normal heating season}$$

Since this is an estimate we might use 8,600 kwh for calculating the probable energy cost per heating season.

In estimating the cost of operation for residences, the lowest bracket of the electric rate should be used. The homeowner should understand that the cost estimate is for space heating only and does not include the cost of operating lights or any other appliances.

If it is desired to itemize this estimated seasonal cost according to average monthly costs to be expected, we may apply the percentages as listed previously.

MONTH		KWH
October	(4%)	350
November	(14%)	1,200
December	(22%)	1,900
January	(24%)	2,100
February	(20%)	1,700
March	(12%)	1,000
April	(4%)	350
TOTAL		8,600

Naturally, this is purely an estimate, since the actual energy usage and its cost are influenced by actual weather conditions, living habits of the occupants, and inside temperature maintained.

SUGGESTIONS FOR INSTALLATION AND OPERATION

Electric heating is successful only when the installation is properly engineered and correctly installed. Accordingly, the economy of operation and added comfort resulting from adequate insulation, weather stripping, and the adherence to other factors discussed herein will more than justify their cost.

Every electric space heating installation should have individual consideration. If provisions suggested in this manual are adhered to, the customer will be assured of:

1. Improved heating and thermal control
2. Proper selection and placement
3. Elimination of excess capacity
4. Adequate insulation
5. Guidance against installation of unapproved and improperly engineered equipment
6. Satisfaction with the operation and its consequent operating cost

HEAT LOSS CALCULATIONS FOR SAMPLE RESIDENCE

Living Room and Hall

Outside walls (net)	208 sq. ft. × 1.3 =	270 watts
Ceiling	366 sq. ft. × 1.1 =	402 watts
Floor	366 sq. ft. × 1.8 =	659 watts
Glass	24 sq. ft. × 14.0 =	336 watts
Door	20 sq. ft. × 7.2 =	144 watts
Infiltration (2,928 cu. ft. × ½ air change)	2,928 × .37 × ½ =	541 watts
Total Heat Loss		2,352 watts

Kitchen, Dining and Family Room

Outside walls (net)	262 sq. ft. × 1.3 =	341 watts
Ceiling	310 sq. ft. × 1.1 =	341 watts
Floor	310 sq. ft. × 1.8 =	558 watts
Glass	32 sq. ft. × 14.0 =	448 watts
Door	18 sq. ft. × 7.2 =	130 watts
Infiltration	2,480 cu. ft. × .37 × ½ =	459 watts
Total Heat Loss		2,277 watts

Bath

Outside walls (net)	56 sq. ft. × 1.3 =	73 watts
Ceiling	40 sq. ft. × 1.1 =	44 watts
Floor	40 sq. ft. × 1.8 =	72 watts
Glass	8 sq. ft. × 14.0 =	112 watts
Infiltration	320 cu. ft. × .37 × ½ =	59 watts
Total Heat Loss		360 watts

Master Bedroom and Half Bath

Outside walls (net)	204 sq. ft. × 1.3 =	265 watts
Ceiling	180 sq. ft. × 1.1 =	198 watts
Floor	180 sq. ft. × 1.8 =	324 watts
Glass	24 sq. ft. × 14.0 =	336 watts
Infiltration	1,440 cu. ft. × .37 × ½ =	266 watts
Total Heat Loss		1,389 watts

Bedroom No. 2

Outside walls (net)	148 sq. ft. × 1.3 =	192 watts
Ceiling	117 sq. ft. × 1.1 =	129 watts
Floor	117 sq. ft. × 1.8 =	211 watts
Glass	16 sq. ft. × 14.0 =	224 watts
Infiltration	936 cu. ft. × .37 × ½ =	173 watts
Total Heat Loss		929 watts

Bedroom No. 3

Outside walls (net)	92 sq. ft. × 1.3 =	120 watts
Ceiling	100 sq. ft. × 1.1 =	110 watts
Floor	100 sq. ft. × 1.8 =	180 watts
Glass	8 sq. ft. × 14.0 =	112 watts
Infiltration	800 cu. ft. × .37 × ½ =	148 watts
Total Heat Loss		670 watts

Bedroom No. 4

Outside walls (net)	68 sq. ft. × 1.3 =	88 watts
Ceiling	105 sq. ft. × 1.1 =	116 watts
Floor	105 sq. ft. × 1.8 =	189 watts
Glass	8sq. ft. × 14.0 =	112 watts
Infiltration	840 cu. ft. × .37 × ½ =	155 watts
Total Heat Loss		660 watts

	Grand Total Heat Loss	8,637 watts

DISCUSSION OF TABLES AND CHARTS

Table I lists average performance data to be expected from various sizes of heat pumps when applied to heat loads as listed.

Table II lists wire sizes for circuits to heaters of various kw capacities. In no case should the wiring circuit between the distribution panel and the heater be subject to greater than a 2% voltage drop, since the capacity of the heater is materially reduced by even a small reduction in rated voltage.

Table III is a tabulation of heat loss coefficients for the types of construction most generally encountered. These coefficients are expressed in watts per square foot of surface area per degree F. temperature difference between inside and outside design temperatures. Some of these coefficients were derived from *The ASHRAE Guide,* published by The American Society of Heating, Refrigeration, and Air Conditioning Engineers, while others were furnished by manufacturers as results of tests made by various testing laboratories.

Table IV shows normal heating degree days per year for major cities.

Figure 1 is a map, showing normal degree days per heating season.

Figure 2 is a bar graph illustrating the effectiveness of insulation, weather stripping and double glazing of windows.

Figure 3 has been discussed earlier. If the heat loss coefficient of the structure or wall material is known and temperature difference between inside and outside temperatures is determined, it may be readily seen from the chart at what point condensation on walls and glass may be expected for any percent of relative humidity.

TABLE I
TYPICAL HEAT PUMP PERFORMANCE DATA
Balance Points at 70° F. Return Air Temperature

Structural Heat Loss at 0° F. (Watts)	Nominal Heat Pump Size: 2 Ton	2½ Ton	3 Ton	4 Ton	5 Ton
8,200	26° F.	20° F.	14° F.	4° F.	0° F.
9,400	32°	26°	20°	10°	5°
12,300	36°	30°	24°	16°	10°
14,400	40°	34°	28°	19°	12°
16,400	—	37°	31°	24°	18°
18,500	—	40°	34°	28°	22°
20,500	—	—	36°	30°	24°
22,600	—	—	38°	33°	27°
24,600	—	—	40°	35°	29°
26,700	—	—	—	37°	31°
28,700	—	—	—	39°	33°
30,800	—	—	—	40°	34°
32,800	—	—	—	—	36°
Basic Heating Capacity at 0° F. (No Supplementary Heat)	2,640 Watts	3,950 Watts	5,000 Watts	7,550 Watts	8,200 Watts
Kw input-cooling	3.00 kw	3.50 kw	4.50 kw	5.50 kw	7.50 kw

$$\text{Heating kWh per heating season} = \frac{\text{kW (heat loss) X DD X 24}}{70^\circ \text{ TD X 2.25*}}$$

*2.25 is the factor for a 25°F (or lower) balance point
2.0 for a 30°F balance point
1.5 for a 35°F balance point

Heat pumps not recommended for balance points above 35°F

Cooling kWh per cooling season = kW input X hrs.**

**700 hrs. for south Kentucky
**800 hrs. for north and central Tennessee
**1,000 hrs. for south Tennessee, Alabama, and Mississippi

TABLE II
WIRE SIZES FOR HEATER CIRCUITS

Heater Size KW	Amperes	Wire Size	Maximum Length of Circuit for 2% Voltage Drop
1.5	6.5	12	213 ft.
2.0	8.7	12	160 ft.
2.5	10.9	12	127 ft.
3.0	13.1	12	107 ft.
3.5	15.2	10	145 ft.
4.0	17.4	10	127 ft.
5.0	21.8	8	161 ft.
7.5	32.5	6	172 ft.
10.0	43.5	4	202 ft.

Never use smaller than No. 12 wire for any heater circuit.

Use nothing smaller than No. 10 wire for 230-volt portable heater circuit.

Kitchen and bathroom heater frames should be grounded.

Each heater should have an individual circuit.

Each heater should have an individual thermostat.

It is recommended that nothing smaller than 200 ampere service capacity be provided for a home using electric space heating.

In any case, all electrical wiring should conform to the *National Electrical Code.*

TABLE III
HEAT LOSS COEFFICIENTS

Loss Through Concrete Block Walls

(8″ Concrete Block with Air Cells, Gravel Agg.)	Btu/Hr. "U" /Sq. Ft. /TD°	Btu/Hr. "R" Factor	Watts Per Sq. Ft. /TD°	Watts At 70° TD	Watts At 60° TD
No Interior Finish, No Insulation	.52	1.9	.152	10.6	9.1
Inside Plaster on Blocks, No Insulation	.48	2.1	.141	9.9	8.5
Inside Furred and Plastered, No Insulation	.30	3.3	.088	6.2	5.3
Inside Furred, Plastered and 2″ Insulation	.09	11.1	.026	1.8	1.6
Inside Furred, Plastered and 3½″ Insulation	.07	14.3	.020	1.4	1.2
Cores Filled with Vermiculite	.38	2.6	.111	7.8	6.7

Loss Through Concrete Block Walls

(8″ Concrete Block with Air Cells, Lightweight Agg.)					
No Interior Finish, No Insulation	.35	2.9	.103	7.2	6.2
Inside Plaster on Blocks, No Insulation	.34	2.9	.100	7.0	6.0
Inside Furred and Plastered, No Insulation	.24	4.2	.070	4.9	4.2
Inside Furred, Plastered and 2″ Insulation	.09	11.1	.026	1.8	1.6
Inside Furred, Plastered and 3½″ Insulation	.07	14.3	.020	1.4	1.2
Cores Filled with Vermiculite	.18	5.6	.053	3.7	3.2

Loss Through Brick and Concrete Block Walls

(4″ Brick and 8″ Concrete Block, Gravel Agg. Block)					
No Interior Finish, No Insulation	.36	2.8	.105	7.4	6.3
Inside Plaster on Block, No Insulation	.35	2.9	.103	7.2	6.2
Inside Furred with Lath and ½″ Plaster	.24	4.2	.070	4.9	4.2
Inside Furred with 2″ Insulation and ½″ Plaster	.09	11.1	.026	1.8	1.6
Inside Furred w/3½″ Insulation and ½″ Plaster	.07	14.3	.020	1.4	1.2
Cores Filled with Vermiculite	.27	3.7	.079	5.5	4.7

Loss Through Brick and Concrete Block Walls

(4″ Brick and 8″ Concrete Block, Lightweight Agg. Block)

	Btu/Hr.		Watts		
	"U" /Sq. Ft. /TD°	"R" Factor	Per Sq. Ft. /TD°	At 70° TD	At 60° TD
No Interior Finish, No Insulation	.27	3.7	.079	5.5	4.7
Inside Plaster on Block, No Insulation	.26	3.8	.076	5.3	4.6
Inside Furred with Lath and ½″ Plaster	.20	5.0	.059	4.1	3.5
Inside Furred with 2″ Insulation and ½″ Plaster	.08	12.5	.023	1.6	1.4
Inside Furred w/3½″ Insulation and ½″ Plaster	.06	16.7	.018	1.3	1.1
Cores Filled with Vermiculite	.17	5.9	.050	3.5	3.0

Loss Through Interior Walls

Studding with Lath & Plaster, One Side	.56	1.8	.164	11.5	9.8
Studding with Lath & Plaster, Both Sides	.32	3.1	.094	6.6	5.6
Studding with ½″ Rigid Insulation, One Side	.36	2.8	.105	7.4	6.3
Studding with ½″ Rigid Insulation, Both Sides	.19	5.3	.056	3.9	3.4
Studding with 3½″ Insulation	.07	14.3	.020	1.4	1.2
8″ Gravel Block	.40	2.5	.117	8.2	7.0
12″ Gravel Block	.38	2.6	.111	7.8	6.7
4″Lightweight Block	.35	2.9	.103	7.2	6.2
8″Lightweight Block	.30	3.3	.088	6.2	5.3
12″ Lightweight Block	.28	3.6	.082	5.7	4.9

Loss Through Ceilings

Lath & Plaster, No Flooring Above	.61	1.6	.179	12.5	10.7
Lath & Plaster with Double Flooring Above	.24	4.2	.070	4.9	4.2
Lath & Plaster with 3½″ Insulation Above	.08	12.5	.023	1.6	1.4
½″ Gypsum Board with 3½″ Mineral Wool Above	.08	12.5	.023	1.6	1.4
½″ Gypsum Board with 6″ Insulation Above	.05	20.5	.015	1.1*	.9

Loss Through Frame Walls with Wood Siding or Shingles

(1″ Wood Sheathing & Moisture Barrier)

Inside Plaster	.23	4.3	.067	4.7	4.0
Inside ½″ Insulating Board	.18	5.6	.053	3.7	3.2
Inside ½″ Insulating Board & Plaster	.18	5.6	.053	3.7	3.2
Inside Plaster with 2″ Insulating Blanket	.09	11.1	.026	1.8	1.6
Inside Plaster with 3½″ Insulation	.06	16.7	.018	1.3*	1.1

Loss Through Solid Brick Walls

(8″ Thick)

Plain Brick, No Inside Finish	.41	2.4	.120	8.4	7.2
Inside Plaster Direct on Walls, No Furring	.39	2.6	.114	8.0	6.8
Inside Furred with ½″ Plaster	.29	3.4	.085	6.0	5.1
Inside ½″ Rigid Insulation Furred on Brick	.22	4.5	.064	4.5	3.8
Inside Furred w/2″ Mineral Wool Insulation	.09	11.1	.026	1.8	1.6
Inside Furred w/3½″ Mineral Wool Insulation	.07	14.3	.020	1.4	1.2

Loss Through Solid Brick Walls

(12″ Thick)

Plain Brick, No Inside Finish	.31	3.2	.091	6.4	5.5
Inside Plaster Direct on Walls, No Furring	.30	3.3	.088	6.2	5.3
Inside Furred with ½″ Plaster	.22	4.5	.064	4.5	3.8
Inside ½″ Rigid Insulation Furred on Brick	.19	5.3	.056	3.9	3.4
Inside Furred w/2″ Mineral Wool Insulation	.08	12.5	.023	1.6	1.4
Inside Furred w/3½″ Mineral Wool Insulation	.06	16.7	.018	1.3	1.1

Loss Through Solid Brick Walls

(16″ thick)

Plain Brick, No Inside Finish	.25	4.0	.073	5.1	4.4
Inside Plaster Direct on Walls, No Furring	.24	4.2	.070	4.9	4.2
Inside Furred with ½″ Plaster	.18	5.6	.053	3.7	3.2
Inside ½″ Rigid Insulation Furred on Brick	.17	5.9	.050	3.5	3.0
Inside Furred with 2″ Mineral Wool Insulation	.08	12.5	.023	1.6	1.4
Inside Furred w/3½″ Mineral Wool Insulation	.06	16.7	.018	1.3	1.1

Loss Through Brick Veneer Walls, Wood Framing & Sheathing	Btu/Hr. "U" /Sq. Ft. /TD°	Btu/Hr. "R" Factor	Watts Per Sq. Ft. /TD°	Watts At 70° TD	Watts At 60° TD
Inside Plaster, No Insulation	.25	4.0	.073	5.1	4.4
Inside ½″ Insulating Board	.20	5.0	.059	4.1	3.5
Inside Plaster with 2″ Mineral Wool Blanket	.09	11.1	.026	1.8	1.6
Inside Plaster w/3½″ Mineral Wool Fill	.07	14.3	.020	1.4	1.2

Loss Through Roofs, Plywood Sheathing
(Pitched Unless Noted)

Flat Metal Roof, No Insulation, No Sheathing	.90	1.1	.264	18.5	15.8
Slate or Tile on Sheathing, No Insulation	.53	1.9	.155	10.9	9.3
Asphalt Shingles or Roll Roofing, No Insulation	.57	1.8	.167	11.7	10.0
Wood Shingles, No Insulation	.60	1.7	.176	12.3	10.6
Flat with Tar and Gravel, Tar and Gravel Board	.30	3.3	.088	6.2	5.3
Asphalt Shingles with ½″ Insulating Board	.25	4.0	.073	5.1	4.4
Slate or Tile with ½″ Insulating Board	.24	4.2	.070	4.9	4.2
Wood Shingles with ½″ Insulating Board	.25	4.0	.073	5.1	4.4
Asphalt Shingles with 3½″ Insulation	.08	12.5	.023	1.6	1.4
Wood Shingles with 3½″ Insulation	.08	12.5	.023	1.6	1.4
Asphalt Shingles with 6″ Insulation	.05	20.5	.015	1.1	.9

Flat Masonry Roofs with Built-up Roofing and 1″ Deck Insulation

4″ Concrete (Gravel Agg.)	.24	4.2	.070	4.9	4.2
6″ Concrete (Gravel Agg.)	.23	4.3	.067	4.7	4.0
2″ Concrete (Lightweight Agg.)	.16	6.3	.047	3.3	2.8
3″ Concrete (Lightweight Agg.)	.14	7.1	.041	2.9	2.5
4″ Concrete (Lightweight Agg.)	.12	8.3	.035	2.5	2.1
2″ Concrete (Gypsum)	.18	5.6	.053	3.7	3.2
3″ Concrete (Gypsum)	.16	6.3	.047	3.3	2.8
4″ Concrete (Gypsum)	.15	6.7	.044	3.1	2.6

Flat Masonry Roofs with Built-up Roofing and 2″ Deck Insulation

4″ Concrete (Gravel Agg.)	.15	6.7	.044	3.1	2.6
6″ Concrete (Gravel Agg.)	.15	6.7	.044	3.1	2.6
2″ Concrete (Lightweight Agg.)	.12	8.3	.035	2.5	2.1
3″ Concrete (Lightweight Agg.)	.10	10.0	.029	2.0	1.7
4″ Concrete (Lightweight Agg.)	.09	11.1	.026	1.8	1.6
2″ Concrete (Gypsum)	.12	8.3	.035	2.5	2.1
3″ Concrete (Gypsum)	.12	8.3	.035	2.5	2.1
4″ Concrete (Gypsum)	.11	9.1	.032	2.2	1.9

Flat Masonry Roofs with Built-up Roofing

4″ Concrete (Gravel Agg.)	.70	1.4	.205	14.4	12.3
6″ Concrete (Gravel Agg.)	.63	1.6	.185	13.0	11.1
2″ Concrete (Lightweight Agg.)	.30	3.3	.088	6.2	5.3
3″ Concrete (Lightweight Agg.)	.23	4.3	.067	4.7	4.0
4″ Concrete (Lightweight Agg.)	.18	5.6	.053	3.7	3.2
2″ Concrete (Gypsum)	.36	2.8	.105	7.4	6.3
3″ Concrete (Gypsum)	.30	3.3	.088	6.2	5.3
4″ Concrete (Gypsum)	.25	4.0	.073	5.1	4.4

Flat Wood Roofs with Built-up Roofing

1″ Wood	.48	2.1	.141	9.9	8.5
2″ Wood	.32	3.1	.094	6.6	5.6
1″ Wood and 1″ Deck Insulation	.21	4.8	.062	4.3	3.7
1″ Wood and 2″ Deck Insulation	.14	7.1	.041	2.9	2.5
2″ Wood and 1″ Deck Insulation	.17	5.9	.050	3.5	3.0
2″ Wood and 2″ Deck Insulation	.12	8.3	.035	2.5	2.1

	Btu/Hr.		Watts		
Preformed Slab Roofs	"U" /Sq. Ft. /TD°	"R" Factor	Per Sq. Ft. /TD°	At 70° TD	At 60° TD
2″ Wood Fiber with Cement Binder	.21	4.8	.062	4.3	3.7
3″ Wood Fiber with Cement Binder	.15	6.7	.044	3.1	2.6
2″ Wood Fiber with Cement Binder and ½″ Acoustic Tile on Furring	.15	6.7	.044	3.1	2.6
3″ Wood Fiber with Cement Binder and ½″ Acoustic Tile on Furring	.12	8.3	.035	2.5	2.1
Loss Through Floors					
4″ Concrete Bare, Above Grade	.45	2.2	.132	9.2	7.9
4″ Concrete with Asphalt Tile, Above Grade	.44	2.3	.129	9.0	7.7
Double Wood	.28	3.6	.082	5.7	4.9
Double Wood, Lath & Plaster Beneath	.24	4.2	.070	4.9	4.2
Double Wood, ½″ Rigid Insulation Beneath Joists	.17	5.9	.050	3.5	3.0
Double Wood, Plaster Beneath & 3½″ Insulation	.07	14.3	.020	1.4	1.2
Double Wood with Asphalt Tile Surface	.26	3.8	.076	5.3	4.6
Double Wood with 1″ Insulating Blanket	.14	7.1	.041	2.9	2.5
Double Wood with 2″ Insulating Blanket	.09	11.1	.026	1.8*	1.6
Double Wood with 3½″ Insulation	.07	14.3	.020	1.4	1.2
Double Wood with 1 Layer Reflective Insulation (+ ¾″ Air Space)	.16	6.3	.047	3.3	2.8
Loss Through Windows, Doors, and Glass					
Glass, Single Thickness	1.13	.88	.331	23.2	19.9
Glass, Double Thickness (¾″ Air Space)	.45	2.2	.132	9.2	7.9
Double Glass (¼″ Air Space)	.57	1.8	.167	11.7	10.0
Single Glass with Storm Window	.68	1.5	.200	14.0*	12.0
Skylight, Single Glass	1.16	.86	.340	23.8	20.4
Skylight, Double Glass (¾″ Air Space)	.48	2.1	.141	9.9	8.5
Hollow Glass Block Wall	.46	2.2	.135	9.5	8.1
Solid Wood Door, Exposed to Outside	.51	2.0	.150	10.5	9.0
Solid Wood Door with Glass Storm Door	.35	2.9	.103	7.2*	6.2

Basement Walls and Floors Below Grade	Btu/Sq. Ft.	Watts/Sq. Ft.
Walls	2.04	.6
Floor	1.02	.3

Concrete Floors At or Near Grade

(Per Lineal Foot of Exposed Edge; 0°-10° Outdoor Design Temperature)

	Btu/Hr.	Watts
No Insulation	60.0	17.6
1″ Edge Insulation	50.0	14.6
2″ Edge Insulation	40.0	11.7

Note Edge Insulation Should Be Installed Between Slab and Foundation Wall and Extend Down 18″ or Horizontally Under Slab 24″

Heat Absorption by Air

W = .0053 Watts Per Cubic Foot Per Degree Fahrenheit

.0053 × 70 = .37 Watts/cu. ft. at 70° TD*

.0053 × 60 = .32 Watts/cu. ft. at 60° TD

.0053 × 35 = .19 Watts/cu. ft. at 35° TD

Air Changes

Residences ½ change per hour

Retail Stores 1 change per hour

Reflective Insulation

If reflective-type insulation is installed in accordance with manufacturer's recommendations, use manufacturer's heat loss coefficients. Caution! *MUST* be properly installed to be effective.

TRANSMISSION FACTORS OBTAINED BY ADDITION OF FIBER INSULATION TO BUILDING SECTIONS

Transmission in Watts No Insulation	Added Insulation Thickness ½″	1″	2″	3″
.205	.089	.057	.033	.023
.176	.083	.054	.032	.023
.146	.076	.051	.031	.022
.132	.072	.049	.030	.022
.117	.067	.047	.030	.022
.103	.062	.045	.028	.021
.088	.056	.042	.027	.020
.082	.054	.040	.027	.020
.076	.051	.039	.026	.019
.070	.049	.037	.025	.019
.064	.046	.035	.025	.019
.059	.042	.034	.024	.018
.053	.039	.032	.023	.018
.047	.036	.029	.022	.017
.041	.033	.027	.020	.016
.035	.029	.024	.019	.015
.029	.025	.021	.017	.014
.023	.021	.018	.015	.012

TABLE IV
NORMAL DEGREE DAYS FOR HEATING SEASON CITIES IN TVA SERVICE AREA

Alabama

City	Degree Days
Albertville	3,406
Birmingham	2,844
*Cullman	3,233
*Decatur	3,374
*Florence	3,576
*Fort Payne	3,415
Huntsville	3,302
Scottsboro	3,341

Georgia

City	Degree Days
Dalton	3,350

Kentucky

City	Degree Days
Bowling Green	4,219
Hopkinsville	4,222
Leitchfield	4,234
*Middlesboro	4,020
Murray	3,893
Paducah	4,025
Russellville	4,172

Mississippi

City	Degree Days
Aberdeen	2,661
Batesville	3,021
Booneville	3,297
Columbus	2,673
Corinth	3,117
Holly Springs	3,308
Jackson	2,300
Kosciusko	2,742
Louisville	2,720
Macon	2,606
Meridian	2,388
Pontotoc	2,865
Tupelo	2,946
Water Valley	2,909

Tennessee

City	Degree Days
*Athens	3,819
Carthage	3,709
Chattanooga	3,505
*Cleveland	3,742
Copperhill	4,049
Covington	3,509
Crossville	4,744
Dickson	3,638
Gatlinburg	4,085
Greeneville	3,935
Jackson	3,581
Knoxville	3,478
Lewisburg	3,869
*Loudon	3,834
McMinnville	3,562
Memphis	3,227
Milan	3,685
Monteagle	4,014
Murfreesboro	3,450
Nashville	3,696
Newbern	3,576
Newport	3,918
Oak Ridge	3,944
Paris	3,882
Rogersville	4,005
Savannah	3,271
*Selmer	3,271
*Tri-Cities Airport	4,306
Tullahoma	3,577
Union City	4,104

*From unofficial weather data.

FIGURE 1

NORMAL DEGREE-DAYS FOR HEATING SEASON
CITIES IN TVA SERVICE AREA

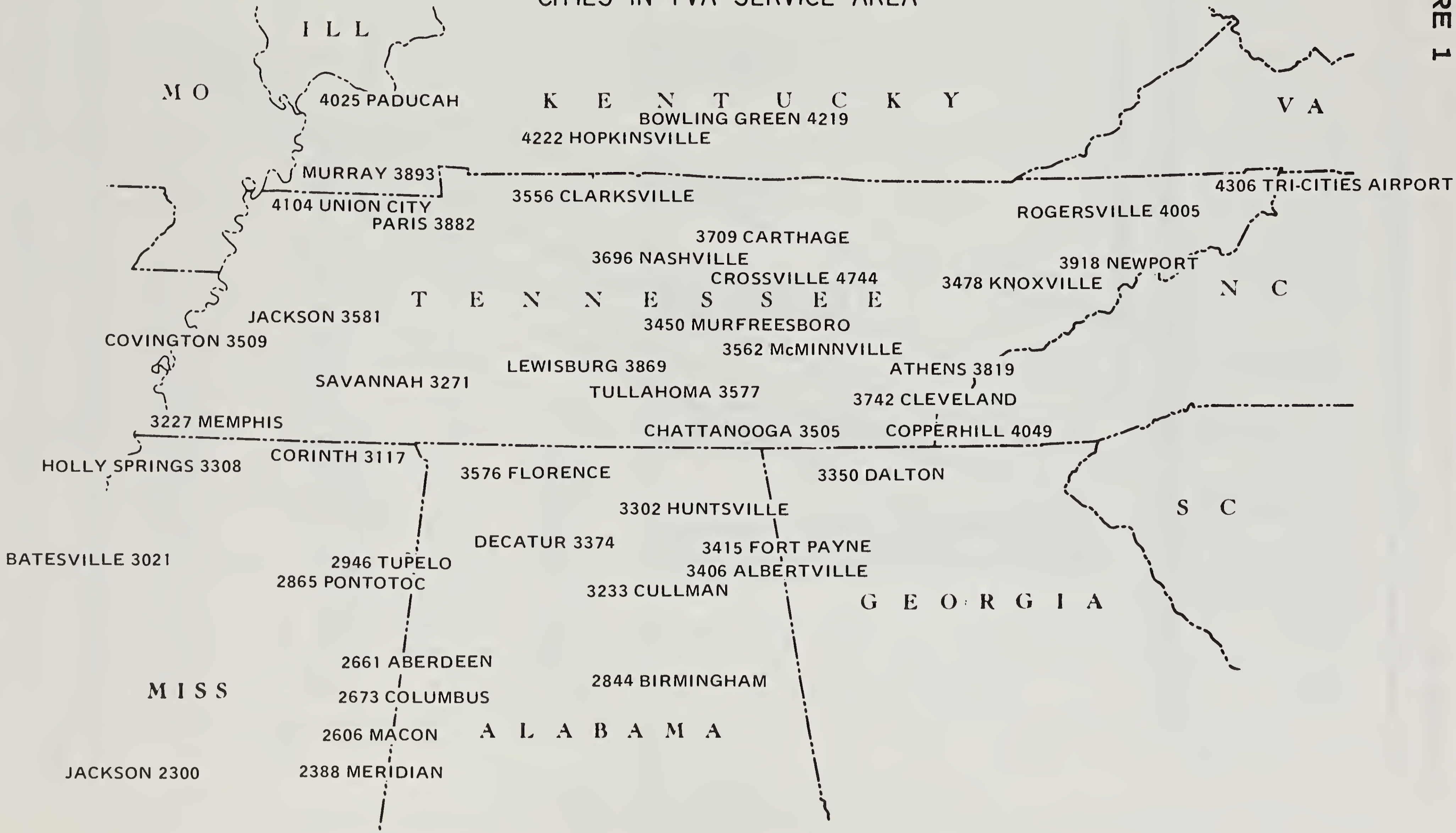
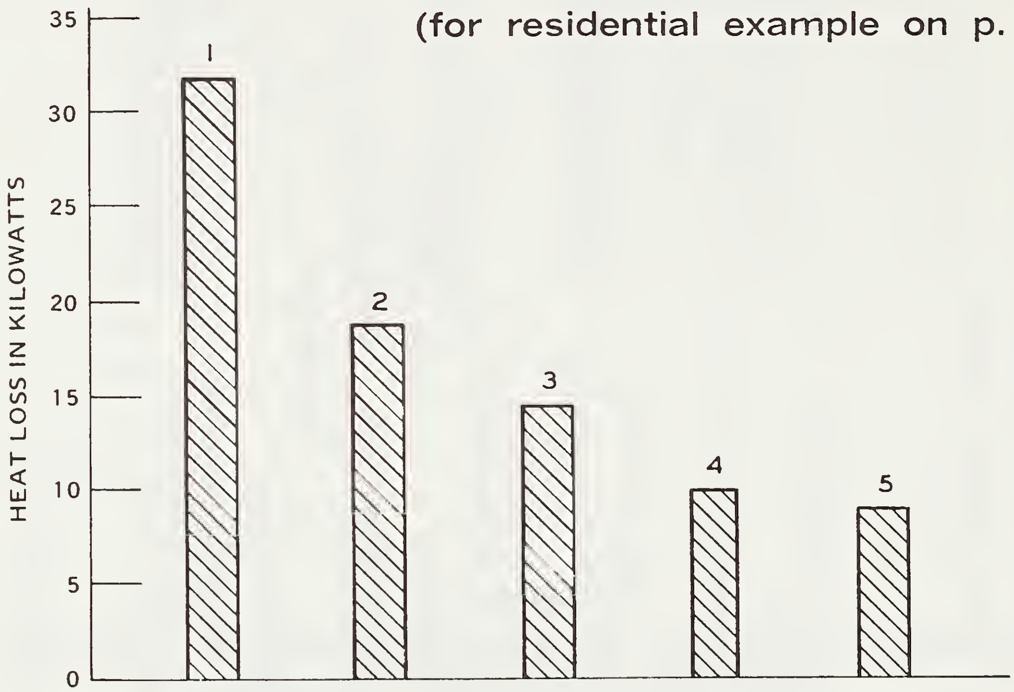


FIGURE 2

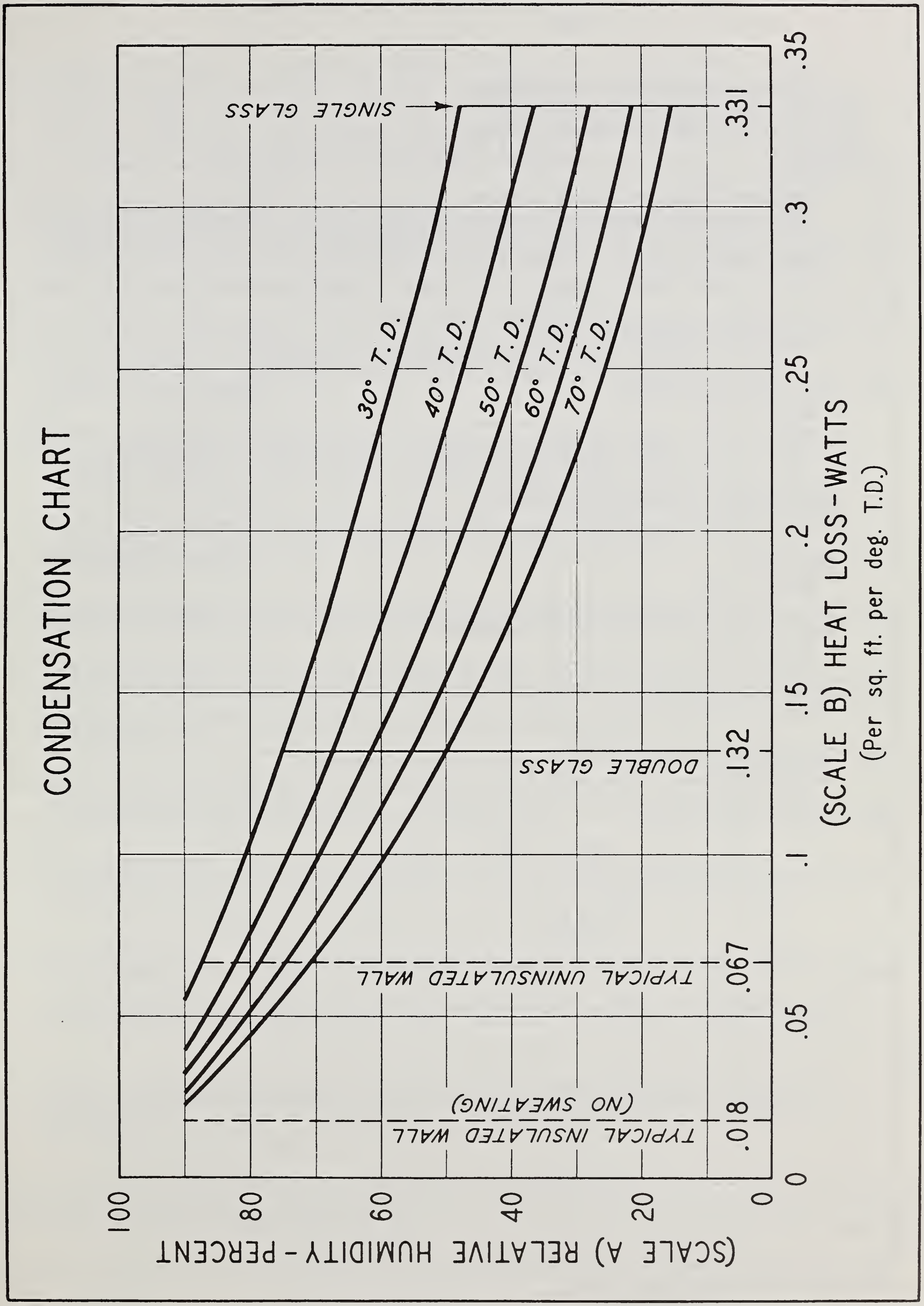
THE EFFECT OF INSULATION ON HEATING CAPACITY

(for residential example on p. 6)



Typical Installation

1. No insulation.
2. Insulation with a value of R-19 over the ceiling.
3. Insulation with values of R-19 over the ceiling and R-11 in the outside walls.
4. Insulation with values of R-19 over the ceiling, R-11 in the outside walls, and R-7 under the floor.
5. Same as #4 with storm windows and storm doors added.


CONDENSATION CHART
SINGLE GLASS
DOUBLE GLASS
TYPICAL UNINSULATED WALL
TYPICAL INSULATED WALL
(NO SWEATING)
30° T.D.
40° T.D.
50° T.D.
60° T.D.
70° T.D.
0
.018
.05
.067
.1
.132
.15
.2
.25
.3
.331
.35
(SCALE B) HEAT LOSS-WATTS
(Per sq. ft. per deg. T.D.)
0
20
40
60
80
100
(SCALE A) RELATIVE HUMIDITY - PERCENT

COOLING LOAD ESTIMATE

Suitable for comfort air conditioning applications not requiring specific conditions of temperature and relative humidity

1. People Number sitting or moving slowly: ________ x 400 = ________ Btuh Number working, dancing, or active: ________ x 650 = ________ Btuh	
2. Windows Facing Sun Total square feet: ________ x ________ A = ________ Btuh	
3. Windows Not Included in Item 2 Total square feet: ________ x ________ C = ________ Btuh	
4. Walls and Partitions Square feet: ________ x ________ C = ________ Btuh Square feet: ________ x ________ C = ________ Btuh Square feet: ________ x ________ C = ________ Btuh	
5. Floor (Over non-conditioned space) Square feet: ________ x ________ C = ________ Btuh	
6. Ceiling Square feet: ________ x ________ C = ________ Btuh	
7. Lighting & Other Electrical Equipment Total watts: ________ x 3.4 = ________ Btuh	
8. Other Heat Sources: ________ B = ________ Btuh	
9. Ventilation or infiltration (Whichever is greatest) Cubic feet per minute: ________ D x ________ E = ________ Btuh	
10. Total Cooling Load: Sum of items 1 through 9 = ________ Btuh	

$$\frac{\text{Total Btuh}}{12{,}000} = \text{Tons refrigeration capacity}$$

Remarks:

TVA 6256 (PM-6-64) Sheet 1 of 3

INSTRUCTIONS FOR ITEMS ON PAGE 20

1. Insert the number of persons normally occupying the space after the air conditioning is installed. If it is a space which would be occupied by a large number of people for only a few minutes' duration and then a smaller number for the remaining time, use the largest number which would be present for approximately 30 minutes' duration.

2. Insert the total square feet of window area of the wall which has the most glass exposed to direct sunshine. Refer to table A and select the proper factor which must be inserted in space indicated. If all of the windows are on the north wall or on a wall shaded completely from the sun by an adjacent building, no figure will appear here.

3. Insert the total square feet of windows not included in item 2. In table C select the factor for these windows under the design outside dry bulb temperature previously established. Insert this factor in space indicated in item 3.

4. Three lines are provided in this item as it is quite possible that several wall constructions may be used on a particular space. In each case subtract the area of the windows from the total wall or partition area and insert the total net wall or partition areas. In table C select the proper wall or partition factor shown under the design temperature already established. Insert these factors on the proper lines at the spaces indicated in item 4.

5. Insert the total square feet of floor area. Refer to table C for the factor to be inserted in the space indicated.

6. Insert the total square feet of ceiling area. Refer to table C for the factor which fits the conditions of the building. Adjust this factor if ceiling is insulated and insert the factor or adjusted factor in space indicated.

7. Insert the total number of watts in use, not including the watts consumed by appliances listed in table B. Lights in store showcases contribute heavily to the load and must not be neglected.

8. Use table B for calculating the heat load due to gas and electrical appliances and motor-driven apparatus. Insert the total in the space indicated in item 8.

9. Use table D for calculating the ventilation or infiltration cfm. The total number of occupants must equal those used in item 1. The infiltration does not include the cfm which would enter space if doors or windows are permitted to remain open. Insert the cfm in space provided.

Refer to table E and select the factor shown under the design outside wet bulb temperature previously established. Insert this factor in space provided.

TABLE A--WINDOWS EXPOSED TO SUN, FACTORS TO BE INSERTED AT A

Direction Windows Face	NE	E	SE	S	SW	W	NW	Horizontal Skylight
Clear glass (single or double) no protection	80	100	110	50	120	180	110	250
Shaded completely by awnings	25	35	45	25	45	50	30	-
Light colored inside shades or venetian blinds	40	50	60	30	60	90	60	-
Glass brick no protection	44	72	64	42	64	72	44	-

TABLE B--OTHER HEAT SOURCES TO BE INSERTED AT B

Beauty parlors	Number of operators: ______	x 2000 =	______
Electric motors	Total nameplate hp: ______	x 2800 =	______
Gas burners*	Number: ______	x 6000 =	______
Glass coffee makers*	Number: ______	x 900 =	______
Coffee urns, gas or electric*	Coffee capacity in gallons: ______	x 1400 =	______
Steam tables, electric*	Sq. ft. area of top: ______	x 550 =	______
Steam tables, gas*	Sq. ft. area of top: ______	x 1300 =	______
Additional heat sources	______	Btu/hr. =	______
*Factors for appliances, with hood & fan, reduce by 50%.		Insert total at B	______

TABLE C--WINDOWS, WALLS, FLOORS AND CEILING TRANSMISSION FACTORS TO BE INSERTED AT C

Outside Design Dry Bulb Temperature °F.	90	95	100
Windows (no sun)	12	17	22
Walls, heavy masonry	3	5	6
Walls, average masonry	4	5	6
Walls, insulated masonry or frame	2	3	4
Walls, average frame	4	5	6
Partition, inside, single thickness	7	10	12
Partition, inside, double thickness	4	5	7
Partition, display window back	14	17	19
Glass brick (no sun exposure)	5	8	10
Floor over non-conditioned space	3	4	5
Ceiling under unventilated attic*	12	13	15
Ceiling under ventilated attic*	9	11	13
Ceiling under flat roof*	14	16	18
Ceiling under occupied floor*	3	5	6

*Adjust factor selected from this table if ceiling is insulated. Example: 4" insulation--0.2 x selected factor = adjusted factor. 1" insulation--0.4; 2"--0.3; 4"--0.2.

TABLE D--VENTILATION OR INFILTRATION QUANTITY TO BE INSERTED AT D

Calculate requirements for both ventilation and infiltration, and use larger quantity cu. ft. per minute (cfm). Use no less cfm than required by local ordinance, and no less than amount drawn from space by exhaust fans if used.

Ventilation Requirements

No. Occupants Smoking			Cfm
None	______	x $7\frac{1}{2}$ =	______
Light	______	x 15 =	______
Heavy	______	x 40 =	______

Infiltration

(H) = Room height
(W) = Width
(L) = Length

$$\text{Cfm} = \frac{(H)\_\_\_ \times (L)\_\_\_ \times (W)\_\_\_}{60}$$

TABLE E--VENTILATION OR INFILTRATION FACTOR TO BE INSERTED AT E

Outside design wet bulb temperature °F.	76	77	78	79	80
Factor	33	37	41	45	49

CASE STUDY 4-2: RESIDENTIAL HEAT PUMPS[1,2]

THE CONCEPT

For many years the heat pump has been recognized as an efficient heating system. It will normally produce two or more units of energy in the form of heat for every unit of electrical energy required in its operation. The Tennessee Valley Authority (TVA) has a program for informing the public, training installation personnel, certifying competent dealers, and inspecting heat pumps after installation. The TVA program has become a model for other utilities.

BACKGROUND

As of 1976, it was estimated that there were approximately 75,000 electric heat pump installations in the TVA service area. Since the heat pump heats a home for approximately 50 percent less, when compared to electric resistance heating, this corresponds to saving more than 500 x 10^6 kWh of electricity every year (equivalent to 260,000 tons of coal saved each year).

Typical efficiency curves for a 2.5 ton heat pump (1 ton = 12,000 Btu/hr = 3.5 kW) are shown in Figure 1. The figure indicates that the COP (coefficient of performance) decreases as the outside air, which is the heat source, decreases in temperature.

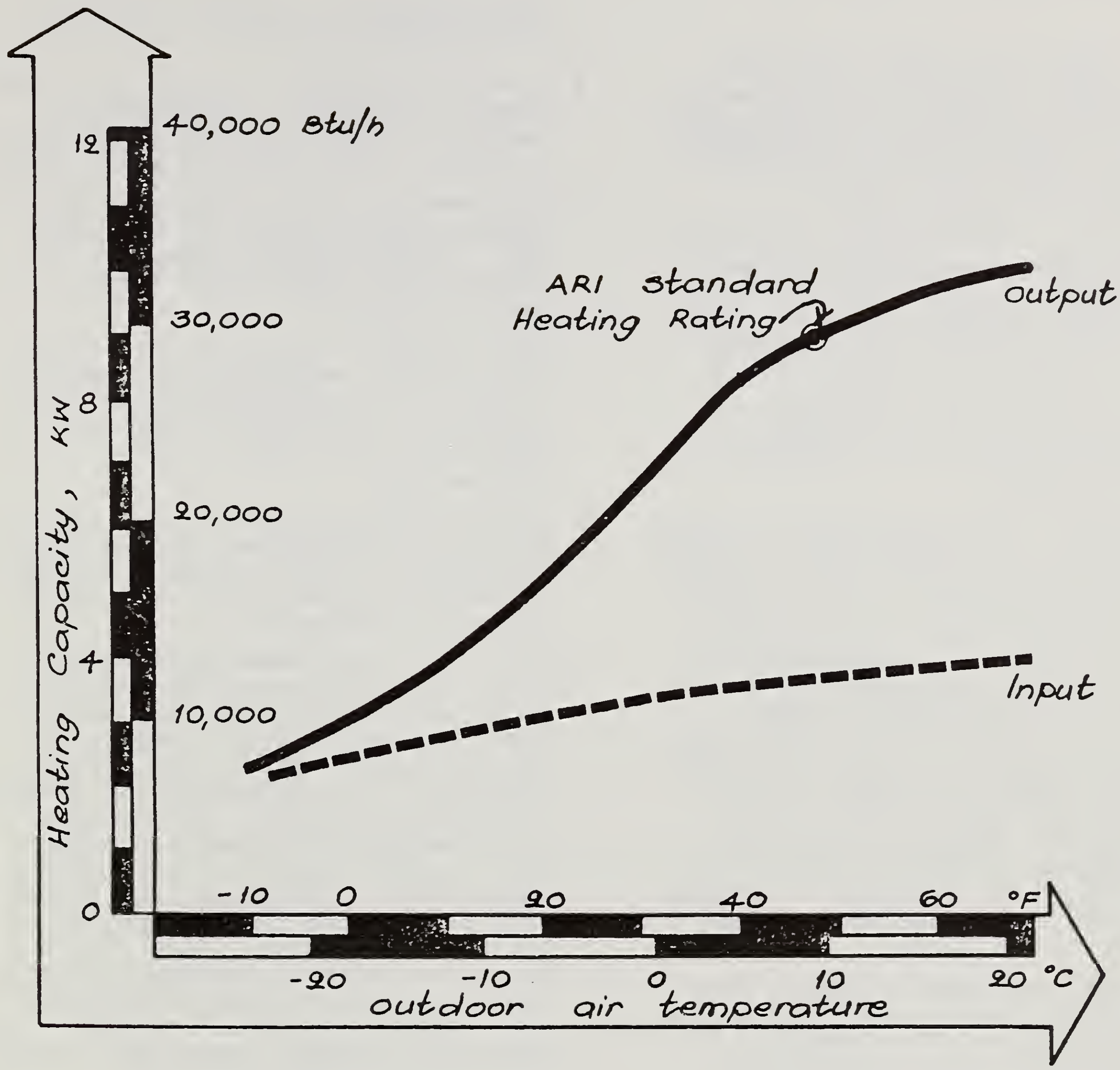
The COP refers to the refrigeration unit operating alone. The auxiliary heat and the defrost cycle also use energy throughout the heating season. Another measure of efficiency, the seasonal performance factor (SPF), includes the additional energy used by this equipment to give a more accurate

	Cost, $	
	Efficient Unit	Inefficient Unit
Initial Cost	200	150
10 Year Operational Cost	360	570
Life Cycle Cost	560	720
	Energy, GJ	
Energy to Manufacture ($\sim$100 MJ/kg)	2.7	2.2
10 Year Operational Energy	77.4	124.0
Life Cycle Energy	80.1	126.2

LIFE CYCLE COST COMPARISON OF TWO AIR CONDITIONERS **TABLE 2**

Electricity Savings in kWh/yr	200	400	600	800
Value of Electricity saved in $/yr (@ 0.05 $/kWh)	10	20	30	40
Acceptable difference in $ (life = 10 years interest @ 8%)	67.10	134.20	201.30	268.40

DIFFERENCE IN ANNUAL COST BETWEEN EFFICIENT AND INEFFICIENT ROOM AIR CONDITIONING UNITS **TABLE 3**



TYPICAL 2½ TON HEAT PUMP PERFORMANCE FIGURE 1

estimate of seasonal energy use.

FINDINGS

The Tennessee Valley Authority has a consumer information program for residential heat pumps. The following is a list of some of their recommendations which should be considered in the purchase of a home unit.

General: The following items are recommended heat pump features. The absence of certain of these features, however, does not indicate that a heat pump will not give reliable and good service.

-All Temperature Compressor: Should operate at outdoor temperatures from -18 to 40°C (0 to 105°F)

-Suction-line Accumulator or other reliable device designed to keep liquid refrigerant from entering the compressor: Since compressors are designed to pump gas, not liquid, it is necessary to have a dry compressor operation through its complete range. Thus, a suction-line accumulator or other device traps and holds back liquid refrigerant which could otherwise enter the compressor. Keeping liquid refrigerant from entering the compressor also lessens the stress on the compressor and reduces wear on its parts.

-Crankcase Heater or some other reliable means of keeping liquid refrigerant from collecting in the compressor crankcase: A crankcase heater helps assure that compressor bearings are properly lubricated by removing liquid refrigerant which can dilute the oil necessary for proper lubrication.

-Liquid-line Filter/Dryer: Helps keep system clean and free of acid and moisture.

The following items are external to the heat pump itself, but they should be given important consideration in order to obtain a good total heat pump system.

- Duct System: Properly designed and adequately sized ducts are of great importance. A heat pump's performance is hampered and some experts assert mechanical problems are hastened by an inadequate duct system, particularly one with undersized air ducts. Ducts must be large enough to provide a minimum of 400 CFM per ton.
- Indoor Thermostat: Should have two stages of heating, one stage for cooling. This is a convenient location for the emergency heat switch.
- Supplemental Heat: Automatic resistance-type heaters in unit or duct. Operate when necessary to maintain the temperature level you've selected.
- Heat Switch: For manual activation of the resistance-type heaters in case the compressor becomes inoperative. Usually referred to as emergency heat switch. It is recommended.
- Outdoor Thermostat(s): Used to prevent the supplemental heaters from switching on before needed, helping to insure a comfortable, efficient, economical operation.
- Size: Let your power distributor assist you in determining capacity. Since an electric heat pump both heats and cools, how do you calculate the size needed? The normal procedure is to determine the amount of cooling required. Then resistance heaters are added to supplement the heat pump at low outside temperatures. This way, the system will produce the right amount of cooling and heating. Once you've found the watts or tonnage required, don't make the mistake of thinking that bigger is better. Get the exact size needed. The same applies to the supplemental heaters.
- Manufacturer: Compare brands, price, and *value*. Look for certification seals such as UL (Underwriters' Laboratories) and ARI (Air-Conditioning and Refrigeration Institute).
- Efficiency Ratings: The energy efficiency ratio, or EER, is an indication of the heat pump's cooling efficiency. The EER is calculated by dividing the cooling capacity in Btu/hr by the power input in watts, and is expressed in Btu/hr per watt.

  The coefficient of performance, or COP, is an indication of the heat pump's heating efficiency. The COP is calculated by dividing the heating capacity in watts by the power input in watts; thus COP is the watts output divided by watts input. The higher the EER and COP, the greater the cooling and heating efficiency of the unit.

ICAA PROFESSIONAL QUALITY INTEGRITY INSULATION CONTRACTORS ASSOCIATION OF AMERICA MEMBER

Insulation Contractors Association of America

member's bulletin

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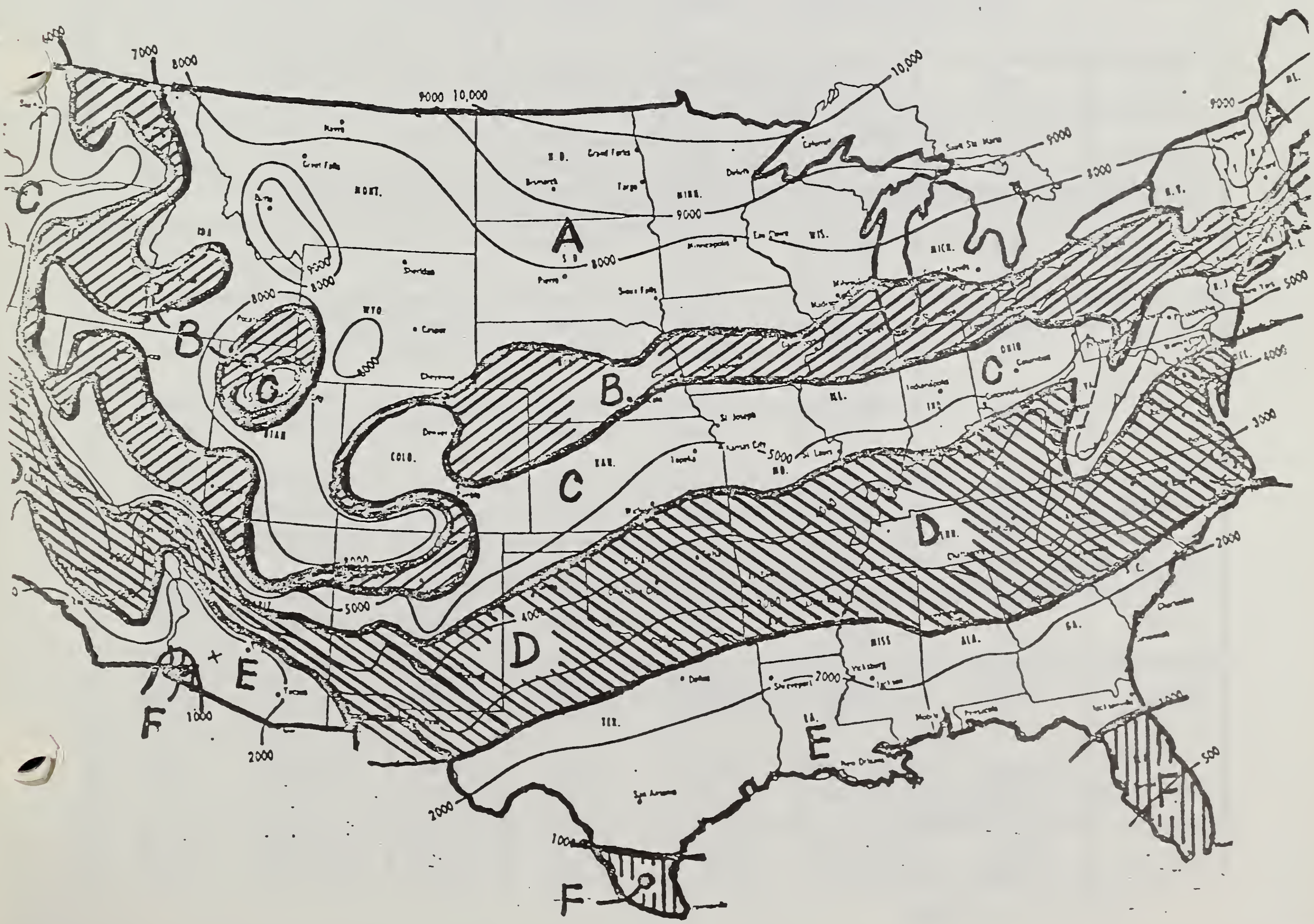
SPECIAL BULLETIN -

FARMERS HOME ADMINISTRATION (FMHA) RESIDENTIAL INSULATION STANDARDS - JULY 1, 1978

The FmHA insulation standards are now official and in force. They are the most rigid national standards published to date, and may well serve as a bellweather for local standards in many areas of the country where weather is severe and/or energy costs are high.

FmHA projects a grant and loan program for housing in Fiscal '79 (from 10/1/78 on) of more than $4 billion, with an assistance program nationally of 177,000 units. This total is new homes, major and minor rehab, and rental unit construction.

The standards vary depending upon winter degree days. The map below gives an approximation of the degree day belts, while the tables and other descriptive information which follow equate the requirements to insulation R-values and combined construction assemblies.



Maximum U-values for Ceiling, Wall and Floors over Open Spaces are as follows: (1)

MAP ZONE	DEGREE DAYS	CEILINGS	FRAME WALLS	FLOORS OVER OPEN SPACES	UNHEATED SLABS	HEATED SLABS
A	7001 or more	0.026	0.05	0.05	5.5-7.5	7.8-10.0
B	6001-7000	0.026	0.05	0.05	4.8-5.5	7.0-7.8
C	4501-6000	0.03	0.05	0.05	3.8-4.8	5.9-7.0
D	2501-4500	0.03	0.05	0.05	2.6-3.8	4.4-5.9
E	1001-2500	0.04	0.07	0.07	0.0-2.6	3.5-4.4
F	1000 or less	0.05	0.08	0.08	No reqt.	0.0-3.5

(1) Values shown for slabs are insulation R-values.

THICKNESSES OF BLOWING WOOL REQUIRED TO MEET VARIOUS CEILING U-VALUES

CEILING SECTION U-VALUE	FRAMING CORRECTION INCLUDED	TYPE OF CEILING/ROOF FRAMING: 2" X 4" BOTTOM CHORDS OF TRUSSES - 24" O.C. — INSULATION TYPE: BLOWN GLASS	BLOWN ROCKWOOL	CELLULOSE FIBER	2" X 8" CEILING JOISTS - 16" O.C. — INSULATION TYPE: BLOWN GLASS	BLOWN ROCKWOOL	CELLULOSE FIBER
FOR NEW CONSTRUCTION OR RETROFIT OF BARE ATTICS - THICKNESS OF BLOWN INSULATION:							
0.05	YES	8.36"	6.76"	5.19"	8.68"	7.29"	5.58"
	NO	8.25"	6.60"	4.95"	8.25"	6.60"	4.95"
0.04	YES	10.61"	8.55"	6.51"	10.89"	9.00"	7.33"
	NO	10.50"	8.40"	6.31"	10.50"	8.40"	6.31"
0.03	YES	14.35"	11.54"	8.75"	14.61"	11.92"	9.37"
	NO	14.25"	11.40"	8.56"	14.25"	11.40"	8.56"
0.026	YES	16.66"	13.38"	10.13"	16.91"	13.74"	10.68"
	NO	16.56"	13.24"	9.94"	16.56"	13.24"	9.94"
THICKNESS OF BLOWN INSULATION OVER NEW OR EXISTING R-11 INSULATION:							
0.05	YES	3.57"	2.85"	2.14"	4.06"	3.35"	2.51"
	NO	3.30"	2.64"	1.98"	3.30"	2.64"	1.98"
0.04	YES	5.79"	4.63"	3.48"	6.22"	5.15"	4.15"
	NO	5.55"	4.44"	3.33"	5.55"	4.44"	3.33"
0.03	YES	9.53"	7.62"	5.72"	9.89"	8.05"	6.25"
	NO	9.30"	7.44"	5.58"	9.30"	7.44"	5.58"
0.026	YES	11.83"	9.46"	7.10"	12.17"	9.86"	7.59"
	NO	11.61"	9.28"	6.97"	11.61"	9.28"	6.97"
THICKNESS OF BLOWN INSULATION OVER EXISTING R-5 INSULATION - RETROFIT ONLY:							
0.05	YES	6.13"	4.94"	3.75"	6.48"	5.43"	4.13"
	NO	6.00"	4.80"	3.60"	6.00"	4.80"	3.60"
0.04	YES	8.38"	6.73"	5.09"	8.69"	7.15"	5.73"
	NO	8.25"	6.60"	4.95"	8.25"	6.60"	4.95"
0.03	YES	12.12"	9.72"	7.33"	12.40"	10.09"	7.84"
	NO	12.00"	9.60"	7.21"	12.00"	9.60"	7.21"
0.026	YES	14.43"	11.56"	8.71"	14.70"	11.91"	9.18"
	NO	14.31"	11.44"	8.59"	14.31"	11.44"	8.59"

DISCUSSION AND TECHNICAL NOTES:

- We have been advised by FmHA that the following blanket insulations will be acceptable regarding compliance with the ceiling U-value requirements:

Ceiling U-value	Insulation R-value
0.05	R-19
0.04	R-22
0.03	R-30
0.026	R-38

It should be noted that not all of the above blankets meet the "full" U-value (0.04 = 0.040) and in some cases fall short if a framing correction is made. FmHA will still accept them as meeting the requirements, and is encouraging field personnel to ignore framing corrections for all building sections.

- With sidewalls, the following insulation/sheathing combinations will meet the U-value requirements:

U = 0.08	-	R-11 + any combination of interior and exterior claddings; no exterior sheathing required for compliance.
U = 0.07	-	R-11 + exterior sheathing in most cases. R-13 with no exterior sheathing required.
U = 0.05	-	R-11 + at least 1" extruded polystyrene sheathing and certain exterior claddings. R-11 + at least 3/4" polyurethane or polyisocyanurate sheathing and any exterior claddings. R-13 + plastic sheathing (1" expanded poystyrene, 3/4" extruded polystyrene or 1/2" urethane or isocyanurate) with any cladding. R-19 blanket with 2" x 6" exterior wood framing.

- Floors over open spaces require R-11 except for the U-value of 0.05, where R-19 is required. Floors above any space without a positive heat supply capable of maintaining 50F. are to be insulated as shown on Page 2.

- Exterior walls of existing residences should be insulated to as close to the above when economically feasible as possible.

- Double glazing is required above 1000 degreedays and triple glazing is required above 4500 degree days in new construction. Double glazing is required above 4500 degree days in existing construction.

- Storm doors are generally required above 2500 degree days and mandatory above 4500 degree days in new construction.

Reasonable numbers of copies of the detailed requirements are available from this office to all contractor and manufacturer members; give us a call or drop a note.

Very truly yours,

Arthur W. Johnson
Executive Director

EFFECTIVE ON MARCH 15, 1978

UNITED STATES DEPARTMENT OF AGRICULTURE
Farmers Home Administration

CONSTRUCTION STANDARDS

I. PURPOSE: This exhibit prescribes construction standards to be used in all Rural Housing (RH) loan and grant programs. These requirements shall supercede those listed in the Minimum Property Standards (MPS) No. 4900.1, "One and Two Family Dwellings," and 4910.1, "Multifamily Housing," as applicable.

II. POLICY: Construction commencing, all applications for new construction approved, or conditional commitments issued after the effective date of this exhibit shall have drawings and specifications prepared to comply with paragraph III A or III C and III D of this exhibit. All existing dwellings to be bought with RH loan funds shall be considered in accordance with paragraph III B or III C of this exhibit.

III. MINIMUM REQUIREMENTS:

A. All dwellings, single family or multifamily to be constructed with RH loan and grant funds shall comply with the following:

NEW CONSTRUCTION

MAXIMUM U VALUES FOR CEILING, WALL AND FLOOR SECTION OF VARIOUS CONSTRUCTION

NOTE: U values are not adjusted for framing; values calculated for components may be rounded.

Winter Degree Days (Note 1)	Ceilings	Walls	Floors (Note 2)	Glazing	Doors (Note 3)
1000 or less	.05	.08	.08	1.13	--
1001 to 2500	.04	.07	.07	.69	--
2501 to 4500	.03	.05	.05	.69	Storm door if hollow core door or if over 25% glass
4501 to 6000	.03	.05	.05	.47	Storm Door
6001 to 7000	.026	.05	.05	.47	Storm Door
7001 or more	.026	.05	.05	.47	Storm Door

EFFECTIVE ON MARCH 15, 1978

Minimum R Values of Perimeter Insulation for Slabs-on-Grade

Winter Degree Days (65 F Base)	Minimum R Values (1) Heated Slab	Unheated Slab
500 or less	2.8	--
1000	3.5	--
2000	4.0	2.5
3000	4.8	2.8
4000	5.5	3.5
5000	6.3	4.2
6000	7.0	4.8
7000	7.8	5.5
8000	8.5	6.2
9000	9.2	6.8
10000 or greater	10.0	7.5

NOTE:

*(1) For increments between degree days shown, U values may be interpolated.

Note 1. Winter degree days may be obtained from the ASHRAE Guide; the "NAHB Insulation Manual for Homes Apartments"; local utilities; and the National Climatic Center, Federal Building, Asheville, NC.

Manuals are available from NAHB RF, Rockville, MD 20850, or NMWIA, 382 Springfield Avenue, Summit, NJ 07901.

Other sources of degree day data may be used if available from a recognized authority.

Note 2. For floors of heated spaces over unheated basements, unheated garages or unheated crawls spaces the U value of floor section shall not exceed the value shown.

A basement, crawl space or garage shall be considered unheated unless it is provided with a positive heat supply to maintain a minimum temperature of 50 F. Positive heat supply is defined by ASHRAE as "heat supplied to a space by design or by heat losses occurring from energy-consuming systems or components associated with that space."

Where the walls of an unheated basement or crawl space are insulated in lieu of floor insulation, the total heat loss attributed to the floor from the heated area shall not exceed the heat loss calculated for floors with required insulation.

Insulation may be omitted from floors over heated basement areas or heated crawl spaces if foundation walls are insulated. The U value of foundation wall sections shall not exceed the value shown. This requirement shall include all foundation wall area, including header joist (band joist), to a point 50 percent of the distance from finish grade to the basement floor level.

Maximum U Values of the Foundation Wall Sections of Heated Basement not Containing Habitable Living Area or Heated Crawl Space.

Winter Degree Days (65 F Base)	Maximum U Value	Glazing *
2500 or less	No Requirement	1.13
2501 to 4500	0.17	1.13
4501 or more	0.10	.69

*Note: Glazing in heated basement shall be limited to 5 percent of floor area unless alternative U_o combination is documented.

Note 3. 1-3/4 inch metal faced door systems with rigid insulation core and durable weatherstripping providing a "U" value equivalent to a wood door with storm door and an infiltration rate no greater than .50 cfm per foot of crack length tested according to ASTM E-283 at 1.567 psf of air pressure, may be substituted for a conventional door and storm door. All doors shall be weatherstripped.

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B. All existing dwellings to be purchased with RH loan and grant funds shall be insulated in accordance with the following:

EXISTING CONSTRUCTION

MAXIMUM U VALUES FOR CEILING, WALL AND FLOOR SECTIONS OF VARIOUS CONSTRUCTION

NOTE: U values are not adjusted for framing; values calculated for components may be rounded.

Winter Degree Days (Note 1)	Ceilings	Walls (Note 2)	Floors (Note 3)	Glazing	Doors (Note 5)
1000 r less	.05		.08	1.13	--
1001 to 2500	.04		.07	.69	--
2501 to 4500	.03		.05	.69	Storm door if hollow core door or if over 25% glass
4501 to 6000	.03		.05	.69	Storm Door
6001 to 7000	.026		.05	.69	Storm Door
7001 or more	.026		.05	.69	Storm Door

Note 1. Winter degree days may be obtained from the ASHRAE Guide; the "NAHB Insulation Manual for Homes Apartments"; local utilities; and the National Climatic Center, Federal Building, Asheville, NC.

Manuals are available from NAHB RF, Rockville, MD 20850, or NMWIA, 382 Springfield Avenue, Summit, NJ 07901.

Other sources of degree day data may be used if available from a recognized autnority.

Note 2. Walls shall be insulated as near to new construction standards as economically feasible. Any exterior wall framing exposed during repair or rehabilitation work shall have vapor barrier installed and be fully insulated.

Note 3. For floors of heated spaces over unheated basements, unheated garages or unheated crawl spaces the U value of floor section shall not exceed the value shown.

A basement, crawl space or garage shall be considered unheated unless it is provided with a positive heat supply to maintain a minimum temperature of 50 F. Positive heat supply is defined by ASHRAE as "heat supplied to a space by design or by heat losses occurring from energy-consuming systems or components associated with that space."

Where the walls of an unheated basement or crawl space are insulated in lieu of floor insulation, the total loss attributed to the floor from the heated area shall not exceed the heat loss calculated for floors with required insulation.

Insulation may be omitted from floors over heated basement areas or heated crawl spaces if foundation walls are insulated. The U value of foundation wall sections shall not exceed the value shown. This requirement shall include all foundation wall area, including header joist (band joist), to a point 50 percent of the distance from finish grade to the basement floor level.

Maximum U Values of the Foundation Wall Sections of Heated Basement not Containing Habitable Living Area or Heated Crawl Space.

Winter Degree Days (65 F Base)	Maximum U Value	Glazing *
2500 or less	No Requirement	1.13
2501 to 4500	0.17	1.13
4501 or more	0.10	.69

*Note: Glazing in heated basement shall be limited to 5 percent of floor area unless alternative U_0 combination is documented.

Note 4. Slab edge insulation should be provided wherever practical in areas of 2500 or more winter degree days. Rigid insulation placed on the exterior face of the slab shall be protected by a durable and weather resistant material.

Note 5. Storm doors not required for double doors, sliding doors or others where installation would be economically infeasible. 1-3/4 inch metal faced door systems with rigid insulation core and durable weatherstripping providing a "U" value equivalent to a wood door with storm door and an infiltration rate no greater than .50 cfm per foot of crack length, tested according to ASTM E-283 at 1.567 psf of air pressure, may be substituted for a conventional door and storm door. All doors shall be weatherstripped.

C. Optional Standards. Housing designs not in compliance with the requirements of paragraphs III A or III B of this exhibit may be approved in accordance with the provisions of this paragraph. Requests for acceptance proposed under paragraph C 1 which will be marketed solely within the jurisdictional area of one FmHA State Office may be approved by the State Director. Requests for acceptance proposed under paragraph C 1 which will be marketed within the jurisdictional areas of two or more FmHA State Offices and all requests for acceptance under paragraph C 2 may be approved by the Administrator.

All submissions of proposed options to the State Director or Administrator shall contain complete engineering data and calculations to document the validity of the proposal. All data and calculations will be based upon the current edition of the ASHRAE Handbook of Fundamentals or other universally accepted data sources.

1. Overall "U" values for envelope components. The following requirements shall be used in determining acceptable options to the requirements of paragraphs III A and III B.

a. U_O (gross wall) - Total exterior wall area (opaque wall and window and door) shall have a combined thermal transmittance value (U_O value) not to exceed the values shown in Figure 1. Equation 1 shall be used to determine acceptable combinations to meet the requirements of Figure 1.

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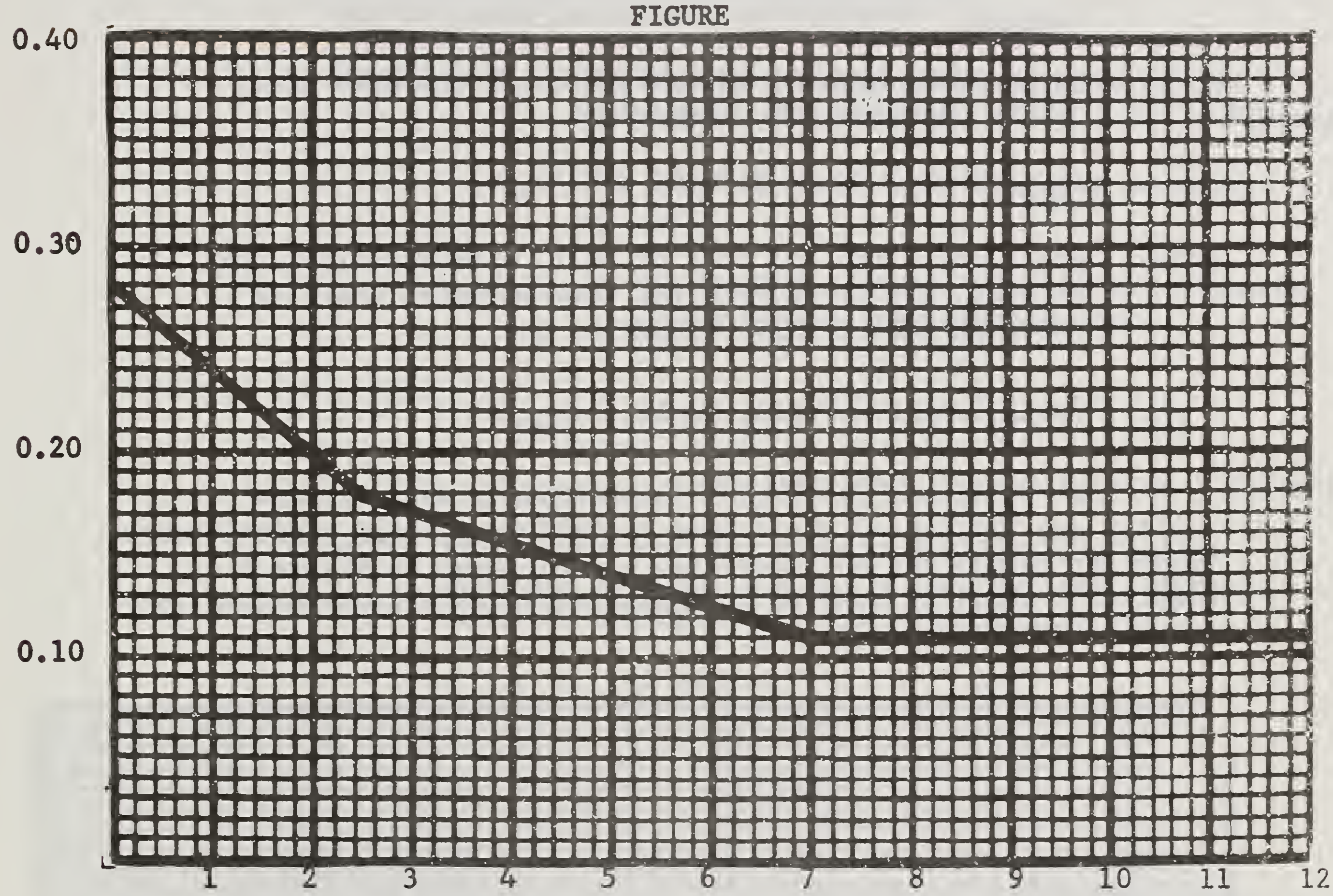
FIGURE



ANNUAL FAHRENHEIT HEATING DEGREE DAYS (65 F BASE) (IN THOUSANDS)

Equation 1 Formula for Determining Combinations (See Fig. 1)

$$U_o = \frac{U_{wall}A_{wall} + U_{window}A_{window} + U_{door}A_{door}}{A_o}$$

where: U_o * = the average thermal transmittance of the gross wall area, Btu/h • ft^2 . F (W/m^2K)

A_o = the gross area of exterior walls, ft^2 (m^2) of heated living areas

U_{wall} = the thermal transmittance of all elements of the opaque wall area, Btu/h . ft^2 . F (W/m^2K) of heated living areas

A_{wall} = opaque wall area, ft^2 (m^2) of heated living areas

U_{window} = the thermal transmitance of the window area, Btu/h . ft^2 . F(W/m^2K)

A_{window} = window area (including sash) ft^2(m^2)

U_{door} = the thermal transmittance of the door area, Btu/h . ft^2 . F(W/m^2K)

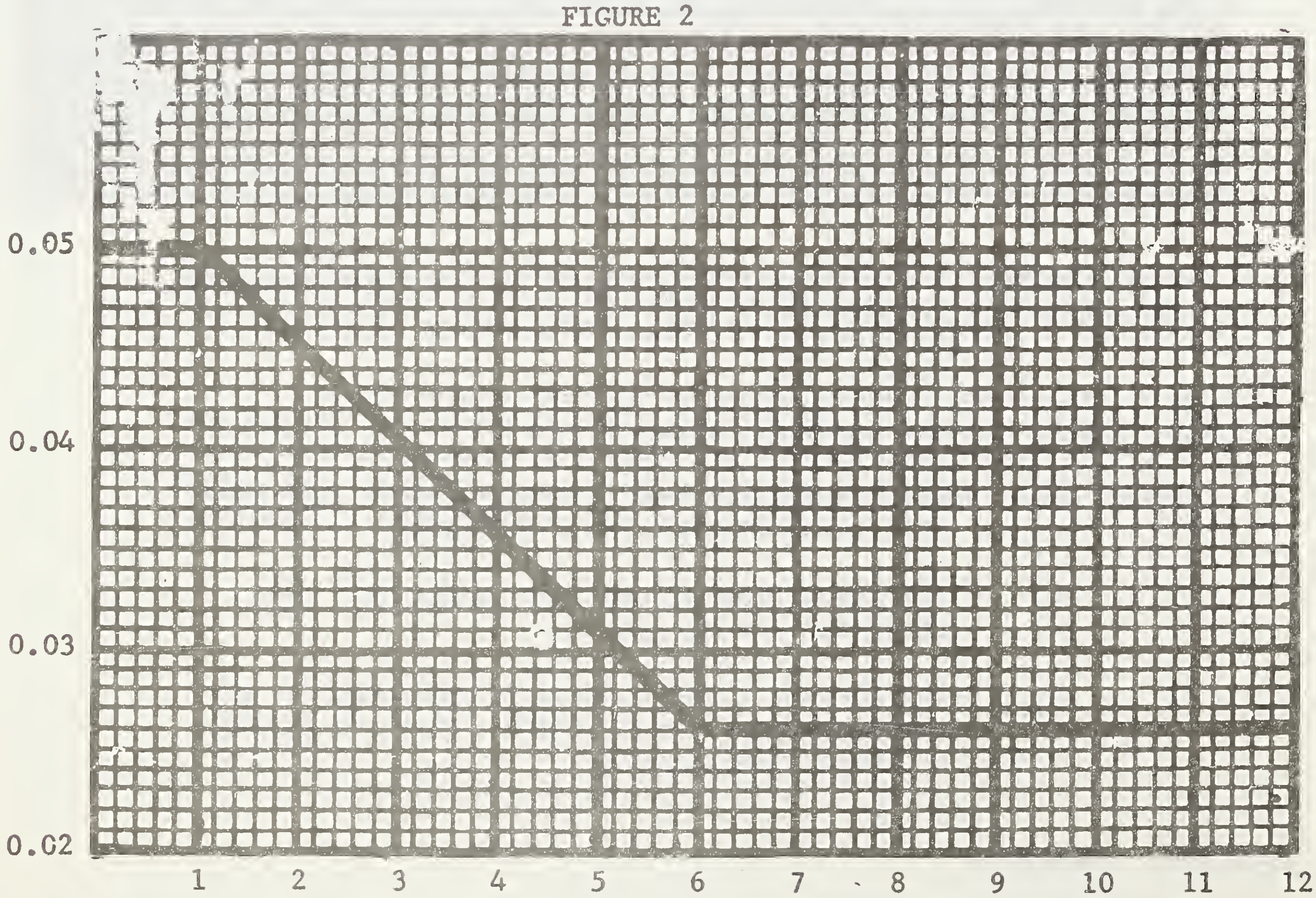
A_{door} = door area, ft^2(m^2)

NOTE: Where more than one type of wall, window and/or door is used, the U x A term for that exposure shall be expanded into its sub-elements, as:

$U_{wall_1} A_{wall_1} + U_{wall_2} A_{wall_2}$, etc.

b. U_o (gross ceiling) - Total ceiling area (opaque ceiling and skylights) shall have a combined thermal transmittance value (U_o value) not to exceed the values shown in Figure 2. Equation 2 shall be used to determine acceptable combinations to meet the requirements of Figure 2.

FIGURE 2



ANNUAL FAHRENHEIT HEATING DEGREE DAYS (65 F BASE) (IN THOUSANDS)

Equation 2 Formula for Determining Roof/Ceiling Combinations

$$U_o = \frac{U_{roof} A_{roof} + U_{skylight} A_{skylight}}{A_o}$$

where: U_o = the average thermal transmittance of the gross roof/ceiling area, Btu/h . ft^2 . F(W/m^{2}K)

A_o = the gross area of a roof/ceiling assembly, ft^2 (m^2)

U_{roof} = the thermal transmittance of all elements of the opaque roof/ceiling area, Btu/h . ft^2 . F(W/m^{2}K)

A_{roof} = opaque roof/ceiling area, ft^2 (m^2)

$U_{skylight}$ = skylight area (including frame) ft^2(m^2)

NOTE: Where more than one type of roof/ceiling and/or skylight is used, the U x A term for that exposure shall be expanded into its sub-elements, as:

$$U_{roof_1} A_{roof_1} + U_{roof_2} U_{roof_2}, \text{ etc.}$$

c. U_o (gross floor) - RESERVED

2. Overall structure performance. The following requirements shall be used in determining acceptable options to the requirements of paragraphs III A and III B:

a. The methodology must be cost effective to the energy user.

b. The methodology must not adversely affect the structural capacity, durability or safety aspects of the structure.

c. All data and calculations must show valid performance comparisons between the proposed option and a structure comparable in size, configuration, orientation and occupant usage designed in accordance with paragraph III A or III B. Structures may be considered for FmHA loan consideration which can be shown by accepted engineering practice to have energy consumption equal to or less than those which would be attained in a representative structure utilizing the requirements of paragraphs III A or III B.

D. Energy efficient construction practices. This section prescribes those items of design and quality control which are necessary to guarantee the energy efficiency of homes built according to the standards of this exhibit. Also included are recommendations for extra energy efficiency in homes.

1. Infiltration:

a. Requirements: All construction shall be performed in such a manner as to provide a building envelope free of excessive infiltration.

(1) Caulking and sealants. Exterior joints around windows and door frames, between wall cavities and window or door frames, between wall and foundation, between wall and roof, between wall panels, at penetrations of utility services through walls, floors and roofs, and all other openings in the exterior envelope shall be caulked, gasketed, weatherstripped, or otherwise sealed. Caulking shall be silicone rubber base or butyl rubber base, conforming to Federal Specifications TT-S-1543 and TT-S-1657 respectively, or materials demonstrating equivalent performance in resilience and durability.

(2) Windows shall comply with ANSI 134.1, NWMA I.S.2.; the air infiltration rate shall not exceed 0.5 ft^3/min per ft. of sash crack.

(3) Sliding glass doors shall comply with ANSI 134.2, NWMA I.S.3.; the air infiltration rate shall not exceed .5 ft^3/min per square ft. of door area.

(4) All insulation placed in open cavity walls shall be installed so that all spaces behind electrical switches and receptacles, plumbing, ductwork and other obstructions in the cavity are insulated as completely as possible. Insulation shall be omitted on the side facing the conditioned area.

Recommendations:

Wrap outside corners of wall sheathing with 15 lb. asphalt impregnated building felt before siding application.

(2) Utilize vestibules for entry doors, especially those facing into the direction of winter wind.

(3) In design of the home, place plumbing, mechanical and electrical in interior partitions as much as possible.

2. Heating and/or Cooling Equipment.

a. Requirements: All mechanical equipment for heating and/or cooling habitable space shall be designed to provide economy of operation.

(1) All space heating equipment (including fireplaces) requiring combustion air shall be sealed combustion types, or be located in a nonconditioned area or adequate combustion air must be provided from outside the conditioned space.

(2) All ductwork shall be designed and installed so as to minimize leakage. All metal to metal connections shall be mechanically joined and taped.

b. Recommendations:

(1) Wherever possible, locate ductwork inside of conditioned areas in dropped ceilings, interior partitions or other similar areas.

(2) Locate outside cooling units in areas not subject to direct sunlight or heat buildup.

3. Vapor Barrier:

a. Requirements: Adequate vapor barriers must be provided adjacent to the interior finish material of the wall.

(1) A vapor barrier at the inside of the envelope component must have a perm rating less than that of any other material in that component and in no case have a perm rating greater than one. All vapor barriers must be sealed around all openings in the interior surface.

(2) All vapor producing or exhausting equipment shall be ducted to the outside and be equipped with dampers.

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b. Recommendation:

(1) Forced air heating/cooling systems should include humidification/dehumidification systems where conditions indicate.

IV. General Design Recommendations:

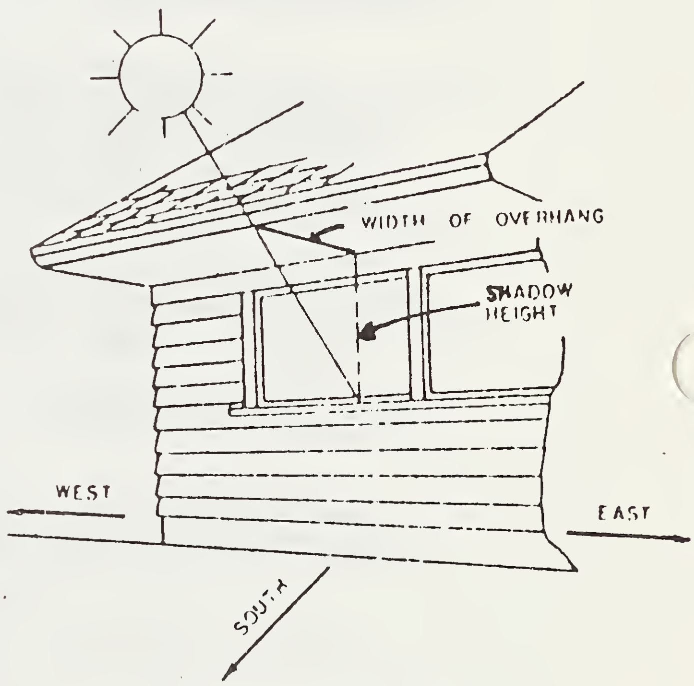
A. Orient homes with greatest glass areas facing south with adequate overhangs to control solar gain during non-heating periods.

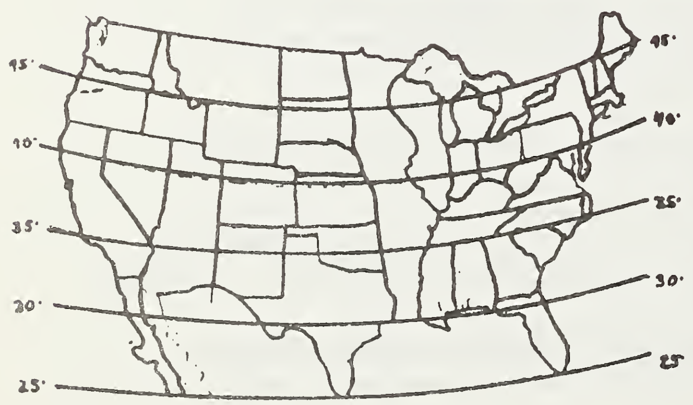
Roof overhangs, or extensions of the roof, over south walls are usually easy to incorporate into house designs. To determine the *width of overhang* needed to shade a south wall or window, follow this method:

(1) Consider the *latitude* of the geographical area in which your house is located. (See map below.) Latitude, together with season of the year, determines the angle at which the sun's rays strike the earth at different times of day.

(2) Measure on your plan or house the number of feet the south windows extend below the eave of the roof or horizontal overhang. This measurement is the *shadow height*.

(3) Then for that specific latitude and shadow height, you will find, from the table given here, the exact width of overhang needed.





NORTH LATITUDE (DEGREES)	SHADOW HEIGHT (FEET) 3	4	5	6	7	8
	WIDTH OF OVERHANG (FEET)					
25	1.1	1.5	1.9	2.2	2.6	3.0
30	1.4	1.9	2.4	2.9	3.4	3.8
35	1.8	2.4	3.0	3.5	4.1	4.7
40	2.1	2.8	3.6	4.3	5.0	5.7
45	2.6	3.4	4.3	5.1	6.0	6.8
50	3.0	4.1	5.1	6.1	7.1	8.2

For example, in a latitude of 35° and for a shadow height of 5 feet, the width of overhang needed is 3 feet.

B. Arrange plantings with evergreen wind buffers on north side and deciduous trees on south.

C. Wherever possible orient entry door away from winter winds.

D. Design house with simple shape to minimize exterior wall area.

E. Minimize glass areas within constraints of required light and ventilation, applicable safety codes and other appropriate considerations.

F. Minimize the amount of paved surface adjacent to the structure where heat gain is not desirable.

o O o

CHAPTER 4

RESIDENCES

T.T. Woodson*

CHAPTER CONTENTS

KEY WORDS

Air Conditioning
Cooking
Cost/Benefit Analysis
Energy Management
Entertainment Use
Environmental Conditioning
Household Appliances
Illumination Practices
Laundry
Product Modification
Refrigeration
Residence Modification
Residential Use
Water Heating

SUMMARY

Energy use in the residential sector accounts for about 20 percent of total US energy use. Of this, natural gas represents 40 percent; fuel oil represents 27 percent; and electricity accounts for the remaining 33 percent.[1] These statistics are based on the primary fuels required. Four-fifths of the energy input to the residential sector is used as either fossil fuel or electric heating. The remaining fifth generates electricity which is used for mechanical drives and lighting. The average per capita direct residential energy use throughout the country is 60-70 GJ/person-year.

A breakdown of this direct residential energy use for United States residences in 1968 is found in Reference 2:

Space heating	57.5%
Water heating	14.9%
Food refrigeration	6.0%
Cooking	5.5%
Air conditioning	3.7%
Lighting	3.5%
Television	3.0%
Food freezing	1.9%
Clothes drying	1.7%
Other	2.3%
	100.0%

Energy use in this sector could be reduced significantly by increasing thermal insulation, reducing infiltration, installing more efficient lamps, modifying appliance operation methods, and improving understanding of energy use facts.

This chapter discusses changes which apply to the following:

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- *operating strategies* which the *user* can readily apply to reduce energy demand significantly;
- *on-site modifications* which the *owner* or *lessor* may undertake practically, resulting in energy and money savings; and,
- *original equipment redesign* which the *manufacturer* or *builder* may develop, leading to appreciable savings in operating cost, in total life cycle costs, and possibly in first cost.

The major actions suggested within the above headings are:

- control settings, schedules of use, ventilation and shading, maintenance, cost comparisons, appropriate lamp selection, careful purchasing, clothing adaptation, color choice, cold water laundry;
- added insulation, weather stripping, duct and piping changes, fluorescent lamps, sector light switching, attic ventilation, other thermal insulation, awnings, pilot light changes, evaluation of central versus room air conditioning, solar pool and water heating, tree planting, roof changes, other site considerations; and,
- substitution of less energy-intensive materials, designs promoting material salvage, mechanism efficiency data, tabulation of available principles, scanning lists of suggestions, process alternatives, and revision of present methods of materials utilization.

Reductions in residential energy use through the changes described in this chapter are estimated to be: 5 to 10 percent immediately; 10 to 15 percent over the near term (2 to 5 years); and an additional 10 to 20 percent over the long term (5 to 25 years). For the year 2000, annual savings in the range of 25 to 45 percent of the residential energy base case appear economically and technically feasible.

4.1 INTRODUCTION AND OVERVIEW

This chapter presents the basic data and methodology necessary to improve energy use efficiency in residences. The suggestions included are derived from many sources--government, utilities, institutions, and the private sector, and range from simple ideas to sophisticated analyses. They have been segregated by potential audience.

The primary agent for conservation varies from topic to topic. Common goals that unite them are (1) prudently designed equipment with salvageable material utilization; (2) economical manufacture and compatible distribution; (3) efficient design and installation; (4) informed operation; (5) equitable energy costs and supply; and (6) overall legislation balancing the interests of consumer, producer, nation, and the environment.

In addition to the applications , design, sales or service engineer, the following people should find interest in this chapter:

apartment manager
appliance service man
building inspector
householder
landlord
legislators and staff
plumber, electrician, etc.
utility representative.

4.2 OBJECTIVE, SCOPE, ASSUMPTIONS

A. Objective, Scope

The objective of this chapter is to present background information and methodologies for more efficient residential energy use. The material included applies primarily to residential electricity and secondly to other energy forms (as gas, oil, etc.). All direct-energy using household equipment and their installations are considered.

The median home of interest typically has three bedrooms, uses 7,000 to 10,000 kWh/yr and has an installed investment in electrical and gas equipment of $3000 to $4000. Domiciles range, of course, from one-room apartments and mobile homes to conventional houses, condominiums, and mansions.

Only direct energy uses in and around the home are included in this chapter. Excluded is the energy embodied in food, clothing, utensils, rugs, furniture, interior furnishings, maintenance supplies, tools, packaging and the like. Those are defined as indirect energy users and are treated separately in Chapters 2, 3, and 6.

For the owner or builder, information is presented to aid in planning economizing changes and modifications, especially in the important area of space heating/cooling.

B. Assumptions

Consumer skills assumed are those of the average urban or suburban family members with little technical background (for operating strategies and modifications) while "designers" (for manufacturing redesign) are assumed to be product engineers or the equivalent. Public officials and lawyers working with engineers will be those chiefly concerned with legal policy alternatives.

The constraints governing an on-site modification are primarily economic (will it pay off in one or two years?) and practical (can changes be made by an electrician or carpenter or by the owner?). The constraints limiting original equipment design changes are primarily:

- continuation of the rule of economics in design, manufacture, sale, use, and salvage;
- use of non-exotic materials or processes;
- retention of generally standard manufacturing methods, although possibly with some changed concepts of fabrication and waste recovery;
- conformity to current US safety standards and legal codes; and,
- the heretofore-used economics of manufacture (material, labor, overhead, etc.) modified by factors accounting for salvage, scarcity, previous energy-to-produce, and environmental impact.

Data for the several residential fuels (electricity, gas,petroleum, etc.) are cited separately. Infrequently, they have been combined and the data appropriately footnoted.

The American National Standards Institute (ANSI), Underwriters Laboratories (National Electric Code), and American Gas Association standards or practices have been assumed, and the usages and recommendations of the various trade and manufacturing associations (NEMA, AHAM, EEI, etc.) are noted.

4.3 USEFUL FACTS AND BACKGROUND

A. General

The following data are included for several reasons: they give a general picture of residential energy growth rates; they provide a factual base for projections; and they serve to suggest the variety of information sources available.

Historical patterns of residential electricity use are shown in Table 4.1. Note that per capita use in 1970 is almost five times what it was in 1950. The economics of energy use (sub-section B) plus the general population growth explain the significant increase in residential electricity sales in recent years. Further detail is provided by Table 4.2. This table illustrates the increasing saturation of energy intensive appliances in US households. Table 4.3 applies this information to summarize residential energy use for all major appliances. Between 1950 and 1970, energy use by each appliance increased an

	1950	1960	1970
Total electricity sales (10^9 kWh)	281	683	1391
Residential electricity sales (10^9 kWh)	70.1	196	448
Residential sales/total sales	24.9%	28.7%	32.2%
Resident population (10^6)	152	180	204
Wired households (10^6)	38.9	51.4	64.0
Residential sales per capita (kWh)	461	1089	2196
Residential sales per household (kWh)	1800	3820	7000
Average size of household	3.37	3.33	3.17

Reference 3

ELECTRICITY SALES, POPULATION, AND WIRED HOUSEHOLDS

TABLE 4.1

	Saturation (%)			Average annual use in households having the appliance (kWh/household)		
	1950	1960	1970	1950	1960	1970
Refrigerators	82.8	98.1	99.8	345	780	1,300
Air Conditioning						
Room	0.8	10.9	26.5	1,402	1,663	1,946
Central	0.1	1.9	11.3	3,560	3,560	3,560
Lighting	100.0	100.0	100.0	500	600	750
Space Heating	0.7	1.8	7.6	10,000	12,945	14,588
Water Heating	10.9	21.0	25.2	3,675	4,010	4,500
Clothes Drying	1.05	12.3	29.1	520	935	993
Ranges	16.2	31.7	40.3	1,250	1,225	1,175
Television	12.9	90.1	94.7	290	335	417
Food Freezers	6.2	19.0	28.0	620	888	1,384
Clothes Washers	73.6	75.9	70.5	45	60	363
Dishwashers	1.7	6.7	18.9	120	347	363
Irons	79.8	88.5	99.6	110	132	144

Reference 3

APPLIANCE SATURATION AND AVERAGE ANNUAL ELECTRICITY USE **TABLE 4.2**

	Total Usage[a] (billions of kWh)			Total Usage (%)		
	1950	1960	1970	1950	1960	1970
Total Residential Sales	70.1	196.4	447.8	100.0	100.0	100.0
Refrigerators	11.1	39.3	82.9	15.8	20.1	18.5
Air Conditioning						
Room	0.4	9.3	32.9	0.6	4.7	7.3
Central	0.1	3.6	25.8	0.2	1.8	5.7
Lighting	19.5	30.8	48.0	27.8	15.7	10.7
Space Heating	2.8	12.1	71.2	3.9	6.2	15.9
Water Heating	15.6	43.3	72.5	22.3	22.1	16.2
Clothes Drying	0.2	5.9	18.5	0.3	3.0	4.1
Cooking	7.9	20.0	30.3	11.2	10.2	6.8
Television	1.5	15.5	25.3	2.1	7.9	5.6
Food Freezers	1.7	10.7	27.7	2.5	5.5	6.2
Other (Clothes Washers, Dishwashers, Irons, Radios, etc.)	9.3	5.9	12.7	13.2	3.0	2.8

[a]Calculated using the relationship:

(electricity consumption per appliance) = (saturation) x (No. of wired households) x (average electricity use per appliance)

with the number of wired households as 38.9 x 10^6 in 1950 51.4 x 10^6 in 1960 and 64.0 x 10^6 in 1970.

Reference 3

SUMMARY: RESIDENTIAL USAGE OF ELECTRICITY

TABLE 4.3

average of 50 percent. Total electricity use due to these appliances, however, increased by a factor of six.

B. Economic Base

Consumer economics fueling this increase in energy use between 1950 and 1970 can be seen in Figure 4.1. Disposable income, electricity cost and appliance price drops combined to yield an increasingly favorable atmosphere for owning appliances and using electricity.

Energy used in US households varies considerably with income. This is illustrated in a study by the Washington Center for Metropolitan Studies in 1973. Figure 4.2 shows household electricity, natural gas and gasoline use by income group. Differences are smallest in the use of natural gas which is used for necessities such as cooking and space and water heating. Electricity use shows a greater difference as non-essential appliances such as air conditioners and automatic dishwashers become more common. Gasoline usage shows the largest difference among income groups.

Table 4.4 indicates the cost of this direct energy use relative to family incomes. Although the "poor" use less, they pay a higher percentage of their total income for energy. The "well off" spend roughly 4 percent of their income on energy, while the "poor" pay in the range of 15 percent. This implies that the benefits of energy efficiency will be comparatively greater for those families which earn less money. These are the people, however, who can least afford improvements in their homes.

C. Basic Facts Related to Operations, On-Site Modifications and Re-Design

This sub-section presents a range of information expected to be of possible conservation value to the user, the owner, and the design engineer. The user is either seeking energy savings per se or striving simply for an optimum cost/benefit balance with existing appliances, furnishings, and structures. Such a user's options are really comprised of:

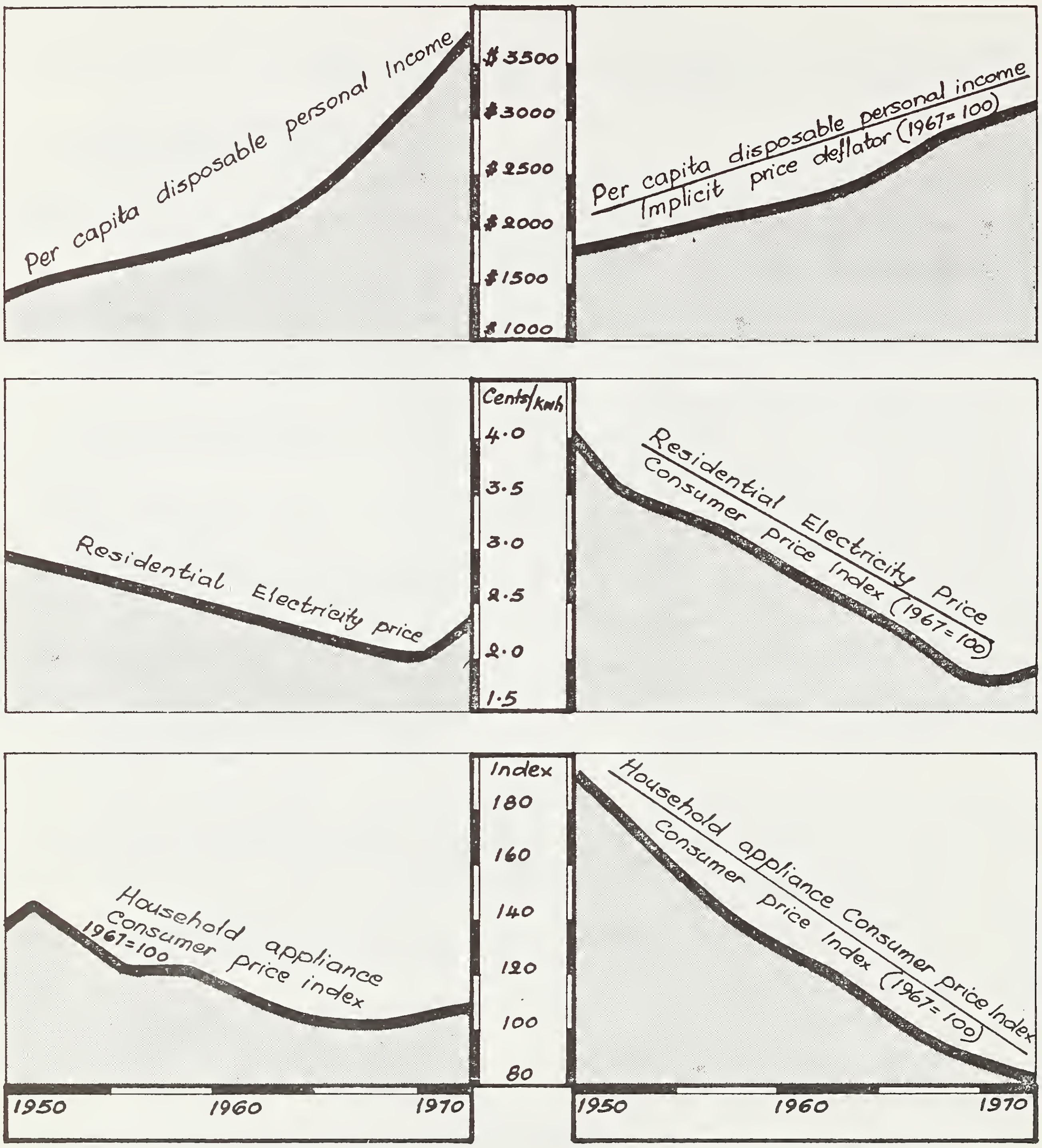
- selecting appropriate means to an end (e.g., shades versus storm windows, pots versus ovens);
- scheduling usage (e.g., duration, cycling, time of day);
- controlling an operating variable (e.g., temperature, water quantity, detergent);
- choosing place of use (e.g., laundry versus kitchen versus porch);
- removing from service (e.g., disconnect or turn off equipment.)

Options for the owner (modifier) are:

- replacing installed equipment with new equipment (lower life-time cost);
- improving installation efficiency (e.g., add insulation, relocate, recircuit); and,
- providing emergency or preventive maintenance (e.g., clean heat exchanger, paint).

The re-designers' options are widespread, but they demand unfettered examination of the alternatives and their total life cycle cost. These options are:

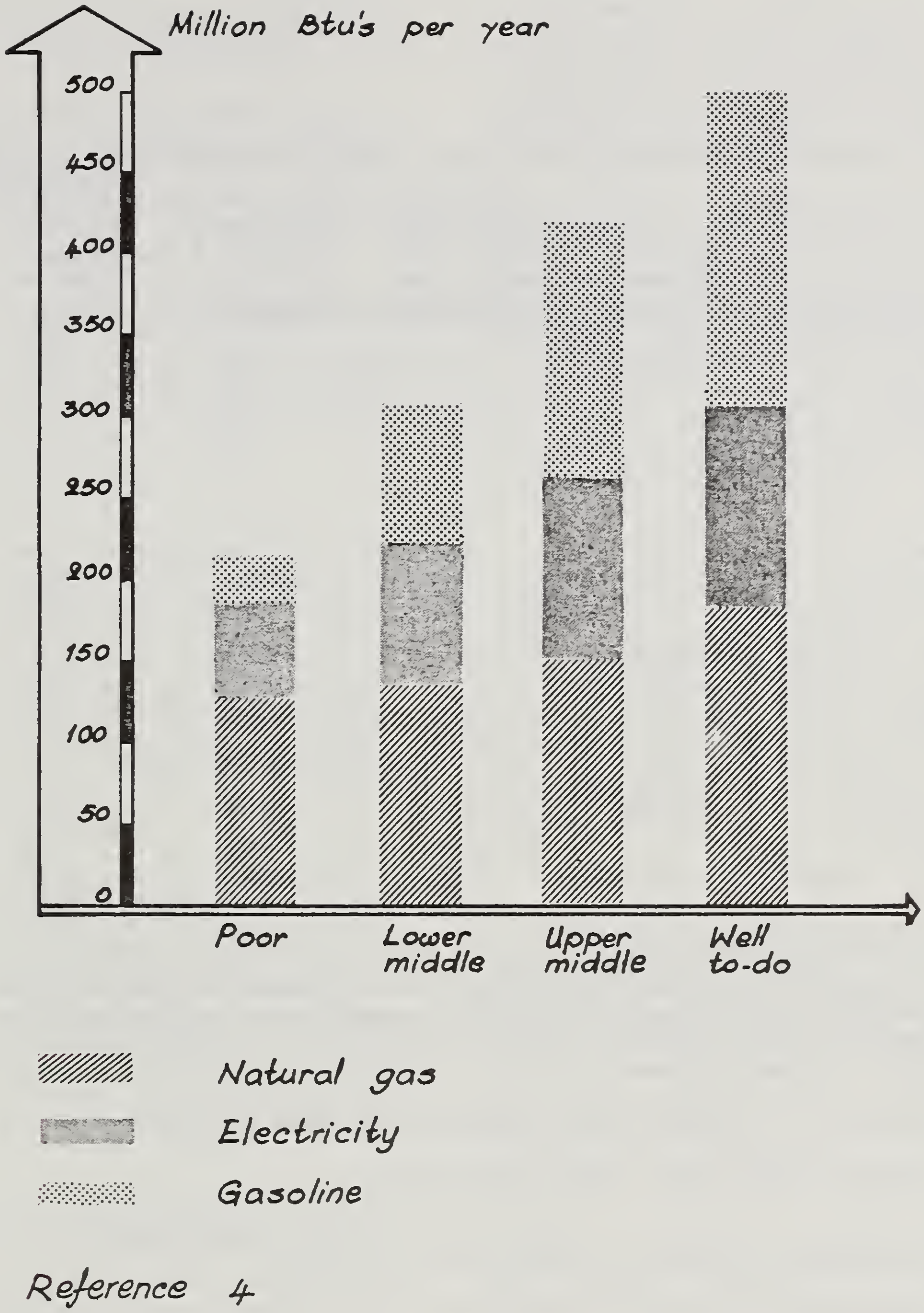
- extended design life of the product, beyond that now in practice;
- new or refined operating principles, new materials, new processes;
- inclusion of material salvage criteria;
- simplified manufacturing processes when production machine maintenance will benefit;
- conversion of "disposables" to "re-usables" where economics indicate;
- minimization of environmental impact of manufacture and use; and,



Reference 3

ECONOMIC FACTORS DETERMINING RESIDENTIAL ELECTRICITY USE

FIGURE 4.1



HOUSEHOLD ENERGY USE BY INCOME GROUP

FIGURE 4.2

Income Status	Average Income	Average Annual Btus (Millions per Household)	Average Annual $ Cost per Household	Percent of Total Annual Income Spent on Energy
Poor: Total	$2,500[a]	207	379	15.2
Natural gas		118	147	5.9
Electricity		55	131	5.2
Gasoline		34	101	4.0
Lower middle: Total	$8,000	294	572	7.2
Natural gas		129	153	1.9
Electricity		80	167	2.1
Gasoline		85	252	3.2
Upper middle: Total	$14,000[b]	403	832	5.9
Natural gas		142	166	1.2
Electricity		108	213	1.5
Gasoline		153	453	3.2
Well off: Total	$24,500[b]	478	994	4.1
Natural gas		174	200	.8
Electricity		124	261	1.1
Gasoline		180	533	2.2

Note: Electricity and natural gas expenditures based on billing data received from utilities. Gasoline expenditures estimated from respondents' quantitative information and the average 1972-73 price of 37¢ per gallon.

[a]77 percent of the poor had incomes less than $3,000.

[b]Calculated from unpublished census data

Source: Washington Center for Metropolitan Studies Lifestyle and Energy Survey, 1972-73 (Reference 4)

THE PERCENTAGE OF FAMILY INCOME SPENT ON ENERGY DECLINES AS INCOME INCREASES

TABLE 4.4

- coordination with emerging governmental and industrial performance standards.

Over all of the above options are economic constraints; what is the pay-out period? Have tooling and inventories been taken into account? What are the probable fuel or energy cost changes over the life of the equipment?

The information and data presented below will assist in decisions for some of the many options above. Some references are listed for further research.

D. Appliances

The following pages discuss the energy use of major appliances and changes that can be made to improve their efficiencies. Table 4.5 shows typical energy use by a variety of residential appliances. For a list of modifications which can be made in a residence, refer to Section 4.4, Suggested Economies.

Space Heating

The use of fossil fuels for residential space heating is common throughout most of the US. A diagram of a typical natural gas system efficiency is shown in Figure 4.3. It reveals the major heat loss to be out of the heater's exhaust stack. Uninsulated ducts could cause even greater loss if they are affected by outside weather.

There are some actions which can be taken to improve the efficiency of an already existing gas or oil space heater--such as reducing stack losses by the dampers and igniters; cleaning and maintenance; reducing capacity to match load by orificing, and direct ducting of combustion air. Most effort should go toward improving insulation and decreasing infiltration of the house itself, as discussed in Chapter 7.

Where electric resistance heating is used, it can provide the ability for room-by-room control, possibly reducing total heating requirements. However, modifications may be economically desirable in some cases. A heat pump can supply roughly twice as much heat for the same input as electric stripheaters. (See the case studies in Chapter 15.)

Several facts should be remembered when installing heat pumps. First, because they generate lower temperature air than strip heating, the heat pump and duct work must be properly sized for maximum efficiency. Second, heat pumps can also be used as air conditioners; thus the initial investment is justified not only by heat savings, but by increased comfort during the summer months.

In most areas of the US, a supplemental heater will be needed because heat pump efficiencies drop off at low temperatures. The heat pump can still supply the majority of heat needed, however. For example, in the colder climates of the US, a heat pump using outside air as a heat source can supply roughly two thirds of the seasonal heating needs.

Air Conditioners

Residential air conditioners are gaining popularity in US homes. Their efficiency is measured by the EER (energy efficiency ratio) which is the number of Btu's per hour of cooling resulting from an electrical input of one watt. Typical EER's for modern air conditioners are shown in Table 4.6. The higher the EER, the more efficient the unit.

Although the amount of energy used by air conditioners varies as the "heat load" changes, the EER is only measured at one point--full load. Some new units use multiple speed motors to draw less energy at lower loads.[5] The EER of these multi-speed units at partial load would be improved compared to the value at full load. Since they are designed to operate at low speed for all but a few hours during the year, these air conditioners are more efficient than EER's indicate.

Another variable in the EER of residential air conditioners is the

ELECTRIC APPLIANCES*

	Power (Watts)	Typical Use (kWh/yr)	Typical Use (GJe/yr)
FOOD PREPARATION			
Blender	300	1	0.0036
Broiler	1,140	85	0.31
Carving Knife	92	8	0.03
Coffee Maker	1,200	140	0.50
Deep Fryer	1,448	83	0.30
Dishwasher	1,201	363	1.31
Egg Cooker	516	14	0.05
Frying Pan	1,196	100	0.36
Hot Plate	1,200	90	0.32
Mixer	127	2	0.0072
Oven, microwave (only)	1,450	190	0.68
Range			
with oven	12,200	700	2.52
with self-cleaning oven	12,200	730	2.63
Roaster	1,333	60	0.22
Sandwich Grill	1,161	33	0.12
Toaster	1,146	39	0.14
Trash Compactor	400	50	0.18
Waffle Iron	1,200	20	0.07
Waste Dispenser	445	7	0.03
FOOD PRESERVATION			
Freezer			
Manual Defrost - 16 cu. ft.	--	1,190	4.28
Automatic Defrost - 16.5 cu. ft.	--	1,820	6.55
Refrigerators/Freezers			
manual defrost, 12.5 cu.ft.	--	1,500	5.40
automatic defrost, 17.5 cu. ft.	--	2,250	8.10
LAUNDRY			
Clothes Dryer	4,856	993	3.57
Iron (hand)	1,100	60	0.22
Washing Machine (automatic)	512	103	0.37
Washing Machine (non-automatic)	286	76	0.27
Water Heater	2,475	4,219	15.19
(quick recovery)	4,474	4,811	17.32
HOUSEWARES			
Clock	2	17	0.06
Floor Polisher	305	15	0.05
Sewing Machine	75	11	0.04
Vacuum Cleaner	630	46	0.17
COMFORT CONDITIONING			
Air Cleaner	50	216	0.78
Air Conditioner (room)	860	860*	3.10
Bed Covering	177	147	0.53
Dehumidifier	257	377	1.36
Fan (attic)	370	291	1.05
Fan (circulating)	88	43	0.15
Fan (rollaway)	171	138	0.50
Fan (window)	200	170	0.61
Heater (portable)	1,322	176	0.63
Heating Pad	65	10	0.04
Humidifier	177	163	0.59

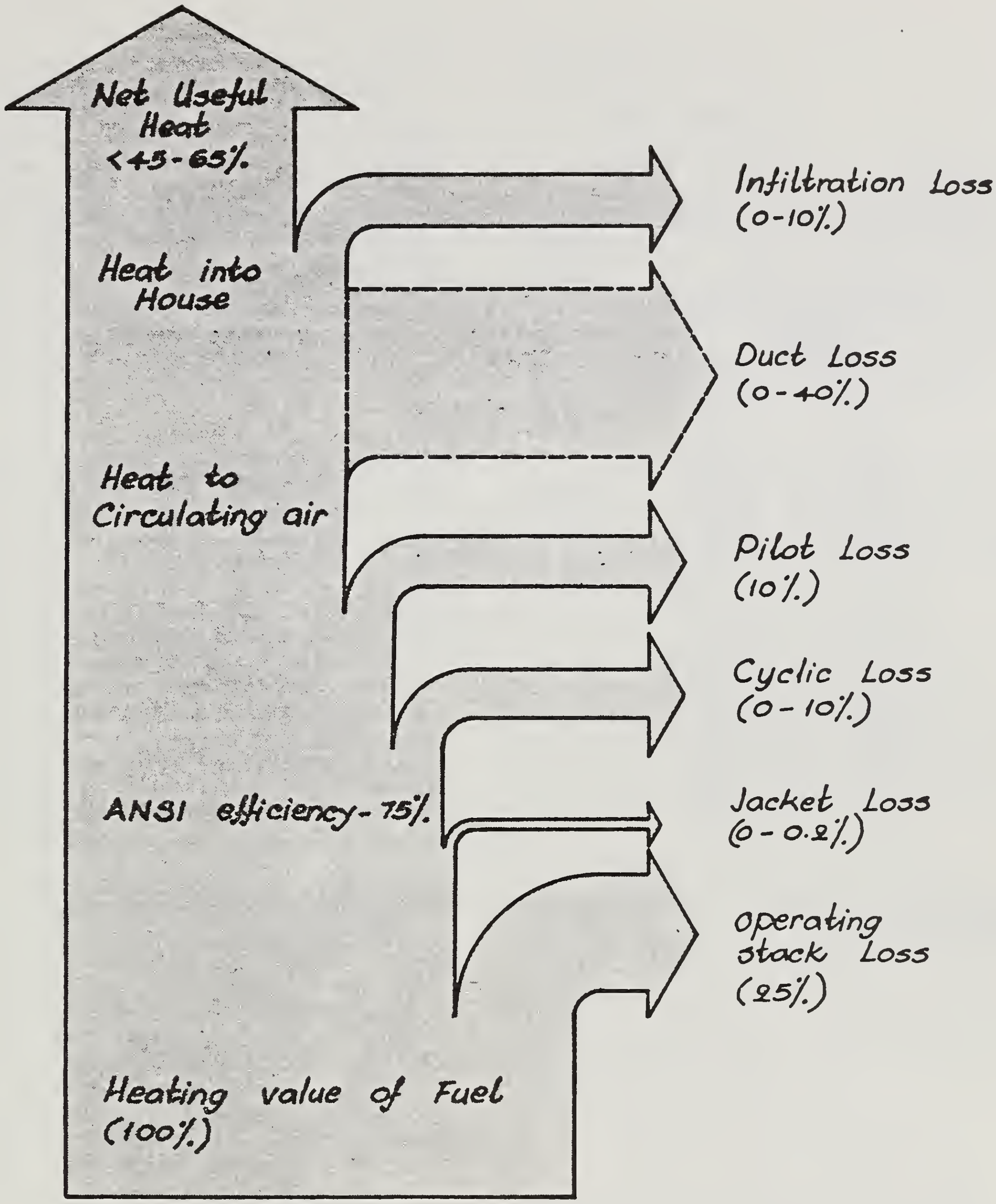
	Power (Watts)	Typical Use (kWh/yr)	Typical Use (GJe/yr)
HEALTH AND BEAUTY			
Germicidal Lamp	20	141	0.51
Hair Dryer	600	25	0.09
Heat Lamp (infrared)	250	13	0.05
Shaver	15	0.5	0.0018
Sun Lamp	279	16	0.06
Tooth Brush	1.1	1.0	0.0036
Vibrator	40	2	0.0072
HOME ENTERTAINMENT			
Radio	71	86	0.31
Radio/Record Player	109	109	0.39
Television			
black & white			
tube type	100	220	0.79
solid state	45	100	0.36
color			
tube type	240	528	1.90
solid state	145	320	1.15

GAS APPLIANCES	Typical Use (kft^3/yr)	Typical Use (GJ/yr)
Clothes dryer	5.0	5.3
Furnace	65	69
Gas light	18	19
Pool heater	50-150	53-158
Range	10	11
Water heater	30	32

*Source: Edison Electric Institute

RESIDENTIAL ENERGY USAGE - TYPICAL APPLIANCES [ELECTRICITY AND GAS]

TABLE 4.5



Reference 5

ENERGY FLOW FOR A GAS FURNACE SYSTEM

FIGURE 4.3

Cooling Capacity Range (Btu/hr)	EER Range 115-V Units	EER Range Higher Voltage Units
Up to 4,999	5.2 to 5.4	--
5,000 to 5,999	5.1 to 8.8	--
6,000 to 6,999	5.6 to 10.5	5.4 to 6.1
7,000 to 7,999	5.2 to 9.2	6.3 to 6.3
8,000 to 8,999	5.8 to 9.9	4.9 to 6.7
9,000 to 9,999	6.4 to 11.5	4.8 to 8.0
10,000 to 10,999	6.3 to 12.0	5.3 to 8.0
11,000 to 11,999	8.0 to 8.5	4.7 to 7.4
12,000 to 12,999	8.7 to 9.6	4.7 to 8.3
13,000 to 13,999	9.4 to 10.0	4.4 to 8.5
14,000 to 14,999	10.1 to 10.3	5.1 to 8.0
15,000 to 15,999	--	4.8 to 8.0
16,000 to 17,999	--	5.8 to 8.5
18,000 to 19,999	--	5.8 to 9.3
20,000 to 23,999	--	5.7 to 8.1
24,000 to 27,999	--	6.1 to 7.6
28,000 to 31,999	--	6.0 to 7.8
32,000 to 36,000	--	6.2 to 7.1

Reference 6

EER RANGE CHART
FOR AVAILABLE 60-Hz UNITS

TABLE 4.6

use of automatic distribution fans. Normal fans remain on while the compressor cycles on and off at low loads. This creates a low EER, as shown in the theoretical curves of Figure 4.4, because the fan is using just as much energy while much less cooling is being done. Automatic fans which cycle off with the compressor give a much higher EER at low loads though they may cause stratification and less precise temperature control within the residence.

An energy saving technique adapted from commercial air conditioning is the use of outside air when its enthalpy (or wet bulb temperature) is less than the air recycled from the residence. This can be advantageous in areas of high humidity and relatively cool nighttime temperatures though it is fairly expensive to install. A simple damper can automatically open and close to minimize energy required to cool the air. Most residences have an advantage over commercial buildings in that their windows can be opened to utilize this free cooling directly.

Since building codes require only a small amount of attic ventilation, it may be advantageous to supplement this if the attic is not insulated. A small fan controlled by a thermostat can exhaust the hot air during the summer and retain it during the winter. Heat gain through the ceiling, a significant part of the heat load, is usually reduced 15 to 40 percent through this modification. It should, of course, be combined with adequate ceiling insulation.

Evaporative cooling is a viable alternative to refrigeration in some climates. It can be made more attractive by designs such as the dry evaporative cooler which uses moist, cool air to cool dry air. The results can be a comfortable atmosphere with only a fraction of the energy necessary for refrigerated air conditioning.

Water Heaters

Water heaters are generally fired by natural gas or electricity. Typical losses during operation are electric, 17 percent, gas-fired, 51 percent.[5] Since electric water heaters use less energy (measured from the outlet) than gas water heaters and are generally better insulated, their standby insulation loss is less than that of gas heaters.

Hot water pipes are an additional source of losses. By reducing the distance between the water heater and the point of use, and by insulating the pipes, such losses can be reduced.

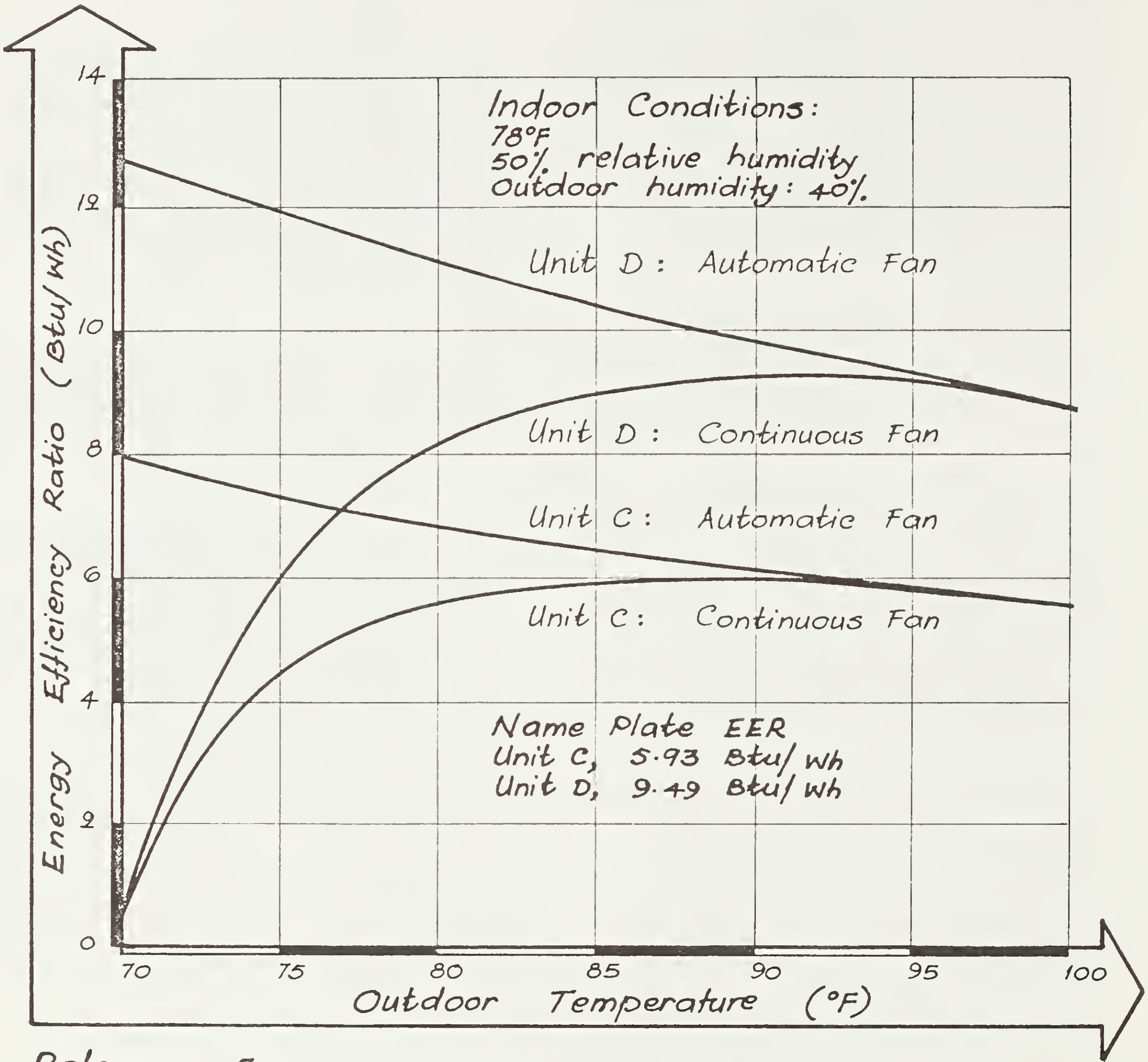
These numbers indicate that the largest savings in the operation of water heaters will result from improvement of burner efficiency, reduction of standby losses, and elimination of the pilot. These and other modifications are detailed in Table 4.7.

Industry standards for heat loss in electric water heaters prescribe a maximum heat loss of 4-6 watts/ft^2. (Natural gas heat loss limits are somewhat higher.) A typical conductivity is 0.17 Btu/hr/ft^2 °F for a 50 gallon electric water heater wall. This can be used to estimate the effects of improvement in insulation.[5]

Refrigerator/Freezers

Between 1925 and 1975 the design of refrigerator/freezers changed considerably. Typical sizes increased from 0.14-0.28 m^3 (5-10 ft^3) to 0.34-0.68 m^3 (12-24 ft^3). The required energy input has also increased from roughly 210 to 490 W/m^3 (6 to 14 W/ft^3).

The theoretical heat loss of a modern refrigerator/freezer is tabulated in Table 4.8. A standard



Reference 5

THEORETICAL EER VARIATION WITH OUTDOOR TEMPERATURE FOR CONTINUOUS AND AUTOMATIC FAN OPERATION

FIGURE 4.4

	Percent Reduction in Annual Fuel Use	
<u>Operating Strategies</u>	<u>Gas</u>	<u>Electric</u>
Lower hot water temperature (per 10 °F reduction)	5.8%	4.5%
<u>Modifications</u>		
Increased tank insulation		
10 cm (4 in.), justified at 1¢/kWh		8.2%
18 cm (7 in.), justified at 4¢/kWh		11.0%
8 cm (3 in.), justified at 10¢/therm	21.6%	
13 cm (5 in.), justified at 40¢/therm	25.0%	
Hot water plumbing insulation (7.5 m (25 ft) of exposed pipe)	1.6%	1.6%
Solar preheat tank	20-60% gas/electric	
<u>Design</u>		
Heat recovery from air conditioning	20-80% gas/electric	
Low excess air	8.0%	
Electric ignition with damper	13.0%	
Reduced flue temperatures	10.0%	
Reduced burner rate	2.0%	
Instantaneous heater with small tank	8.0%	
Heat pump water heater	50.0%	
Programmed off periods	10.0%	
Indirect heater with electric pilot	17.0%	
Ambient preheat tank	8.0%	
Condensation of flue gases	9.0%	

Reference 5

ENERGY SAVING MODIFICATIONS FOR WATER HEATERS

TABLE 4.7

Compartment	Heat Transfer through Walls	Door Openings	Total
Freezer	42 W	4 W	46 W, 33%
Refrigerated Compartment (GRC)	58 W	14 W	72 W, 51%
	100 W, 71%	18 W, 13%	118 W, 84%
Other Items			
Anti-Sweat Heaters (40% of 20 W)			8 W, 5.5%
Air Circulation Fan			7 W, 5.0%
Defrost Heaters (1.6% of 500 W)			8 W, 5.5%
			141 W, 100%

Notes:

1. GRC = general refrigerated compartment.
2. 27 °C (80 °F) Ambient, 3 °C (37 °F) GRC, -18 °C (0 °F) freezer.
3. 50 door openings/day for GRC.
4. 25 door openings/day for freezer.
5. GRC volume = 0.31 m^3 (10.8 ft^3), freezer volume 0.12 m^3 (4.2 ft^3).
6. Door openings assume 60% relative humidity and complete air change for each opening.

Reference 5

HEAT LOSS OF A TYPICAL REFRIGERATOR / FREEZER

TABLE 4.8

sized unit is used (with a freezer volume of 0.12 m^3 [4.2 ft^3] and a refrigerator volume of 0.31 m^3 [10.8 ft^3]). It is apparent from the results shown in the table that the largest heat loss results from thin walls and insufficient insulation.

Electrical input to the refrigerator is used to remove this acquired heat. Table 4.9 gives a breakdown of the energy which is necessary to operate the same typical refrigerator. The operation of the compressor is responsible for about three-quarters of the total energy use.

Anti-sweat heaters are used in many locales to prevent condensation on the exterior of refrigerator/freezers. Heat is either supplied by a resistance heater or part of the condenser loop waste heat. When the source is electrical resistance heating, it can generally be turned off by a "Power Saver" switch during dry weather. If the resistance heater is left off for two thirds of the time or more, it will use less energy than the condenser loop which cannot be turned off.

Table 4.10 shows the sensitivity of electricity use to variations in the operation of a refrigerator. For example, by increasing the temperature setting 1 °C, energy use drops by about 8 percent. In addition, opening the door three times will increase the energy use by roughly 1 percent.

In the purchase of a new refrigerator, efficiency should be an important consideration. Units are available with added insulation and efficient compressors which decrease the yearly energy use by 25 to 45 percent. Information on energy efficiency of specific models is available from the Association of Home Appliance Manufacturers (AHAM).[7]

Proper temperatures for storing a variety of foods are shown in Tables 4.11 and 4.12. With this information the consumer can ensure that the maximum safe storage temperatures are used for the greatest efficiency.

Split phase motors with a capacitor start are commonly used in domestic refrigerator compressors. They have an aluminum cast rotor with carbon steel laminations and a copper-wound stator. Modifications to improve efficiency could include the following:

- add more copper to the stator,
- add more iron to the magnetic circuit,
- add another capacitor for the run mode.

The efficiency would be increased roughly 12 percent by these improvements.

Ovens/Ranges

This sub-section contains a brief description of cooking equipment design. For a discussion of cooking techniques, please refer to the case studies in Chapter 15.

Heat loss from a typical oven occurs in four major areas:

Oven door edge	200 W
Oven window	70 W
Air circulation	80 W
Insulation	520 W

Improvements in the oven door may be possible by using titanium bolts to join the inner and outer walls. These offer a lower thermal conductivity than common metals.

Standard oven insulation is 3.8 cm (1.5 in) of fiberglas. Improvements can be made by using other materials or thicker walls. Self-cleaning ovens normally are built with more insulation than common ovens. Due to improved efficiency during normal usage, their average energy use is not significantly greater, despite periods of high demand.

Much of the heat loss in ranges results from inefficiencies in burner design. Effective surface burner efficiencies are 30 to 50 percent for gas and 50 to 70 percent for electricity. Capacity for improvement exists, possibly in the design of pots and pans to couple more effectively with the burners.

	Average Watts
Anti-sweat heater	20
Fan motor	7
Defrost heater	8
Compressor motor, electrical and mechanical losses (based on 66.7% efficiency)	58
Compressor friction loss (based on mechanical efficiency of 80%)	23
Vapor compressor power: Lower limit [based on ideal coefficient of performance of 4.72 for R-12 refrigerant between -18 °C (0 °F) and 27 °C (80 °F)]	30
Extra power required for:	
Lower evaporator temperature -28 °c (-18 °F)	12
Higher condenser temperature 6 °C (+42 °F)	26
Superheat at compressor limit 71 °C (+160 °F)	11
Miscellaneous inefficiencies	15
Total Input Power	210

Reference 5

INPUT POWER DISTRIBUTION OF A REFRIGERATOR / FREEZER

TABLE 4.9

Operation Change	Resulting Change in Electricity Use	
Temperature setting	-7 to 9%/°C	(-4 to 5%/°F)
Room temperature	+3.6%/°C	(+2%/°F)
Door opening (at 60% RH)	+0.3%/Opening	
Food load at ambient	+3.5%/kg	(1.6%/lb)

Reference 5

REFRIGERATOR / FREEZER ENERGY USE VARIABLES

TABLE 4.10

Article	Temperature °F	Article	Temperature °F
Game, to freeze	0	Flowers, cut	36
Poultry, to freeze	0	Ginger Ale	36
Fish, to freeze	5	Grapes	36
Game, after frozen	10	Cucumbers	38
Poultry, after frozen	10	Lemons	38
Butter	14	Sauerkraut	38
Fish, salt water, not frozen	15	Berries, fresh	40
Ice cream	15	Cantaloupes, short carry	40
Scallops, after frozen	16	Fish, dried	40
Fish, fresh water, frozen	18	Fruits, canned	40
Cabbage	20	Fruits, dried	40
Hams, not brined	20	Meats, canned	40
Livers	20	Nuts, in shell	40
Oleomargarine	20	Sardines, canned	40
Fish, not frozen, short carry	28	Watermelons, short carry	40
Furs	28	Buckwheat flour	42
Game, short carry	28	Cornmeal	42
Apples	30	Oatmeal	42
Beef, fresh	30	Tomatoes, ripe	42
Eggs	30	Wheat flour	42
Poultry, dressed, iced	30	Meats, salt, after curing	43
Beans, fresh	32	Oysters, in shell	43
Celery	32	Beans, dried	45
Cider	32	Beer, in bottles	45
Lambs	32	Corn, dried	45
Onions	32	Honey	45
Plums	32	Maple syrup and sugar	45
Cantaloupes, long carry	33	Oils	45
Carrots	33	Peas, dried	45
Cranberries	33	Sugar	45
Cream	33	Syrup	45
Pears	33	Peaches	50
Tenderloins	33	Wines	50
Oranges	34	Bananas	55
Potatoes	34	Dates	55
Cheese	35	Figs	55
Milk, short carry	35	Raisins	55

Reference 8

APPROXIMATE COLD STORAGE TEMPERATURES

TABLE 4.11

Product	Months	Product	Months
Meat, fresh		Other Foods	
Beef, steaks or roasts	9-12	Butter and cheese, except cottage cheese (do not freeze cream cheese)	6-8
Beef, ground	4-6	Eggs, yolks and whites separated	12
Beef or lamb liver	3-4	Fruits and vegetables	10-12
Lamb	9-12	Fruit juices	up to 16
Pork	4-6	Ice cream	1-2
Pork, ground	1-3	Cook or Prepared Foods	
Pork, sausage	1-3	Baked pies, biscuits, muffins	2
Meat, smoked		Baked yeast bread and rolls	6-8
Bacon, slab (Do not freeze bacon)	1-3	Cakes (unfrosted), fruit cakes, unbaked fruit pies	6-8
Frankfurters	1-3	Leftovers, fried foods, newburgs, thermidors, pasta dishes	1
Ham, whole	1-3	Roast beef, lamb, veal, and chicken	4-6
Sausage	1-2	Roast pork and turkey, stews	2-4
Poultry, fresh		Soups	6
Chicken, ready-to-cook	12		
Ducks, geese, ready-to-cook	6		
Fish and Shellfish			
Lean fish	4-6		
Fatty fish, clams, oysters	3-4		
Cooked crabmeat and lobster	2-3		
Meat	2-3		
Cooked shrimps	1-2		

Reference 8

MAXIMUM FROZEN FOOD STORAGE TIMES AT −17.7°C

TABLE 4.12

Finally, microwave ovens offer not only more efficient heating but also shorter cooking times. (See the case studies in Chapter 15.)

Clothes Washers

Most of the energy used by clothes washers is employed in heating water rather than in the electrical drives. This is illustrated in Figure 4.5 which gives the energy efficiency of several competitive washing machines.

The energy used by washers, therefore, is best limited by controlling water quantity and temperature in the wash and rinse cycles. A hot water wash is not generally required, but may be advantageous for special purposes such as cleaning heavily soiled white clothes or removing oil and grease stains. Generally, it is necessary to use water at 50 °C (122°F) and detergent to emulsify animal oils and fats during the wash cycle. Clothes are just as clean (in terms of bacteria count) after a 20 °C (70 °F) wash as after a 50 °C (122 °F) wash. If there is concern for sanitation (e.g., a sick person in the house), authorities recommend use of a chlorine bleach.

Many manufacturers contend that there is little or no need for anything other than a cold rinse. Typically, a warm rinse capability is provided solely because of consumer demand. Some machines do not even allow a hot wash/cold rinse or warm wash/cold rinse control option.

In the United States the use of colder temperatures in clothes washers is beginning to be accepted by the public. The following data from Reference 5 show cycle selection for a washer with five combinations of wash/rinse temperatures.

Wash/Rinse Temperature Setting	1971 Survey Use Factor	1975 Survey Use Factor
Hot/warm	.25	.18
Hot/cold	.15	.12
Warm/warm	.30	.30
Warm/cold	.20	.25
Cold/cold	.10	.15

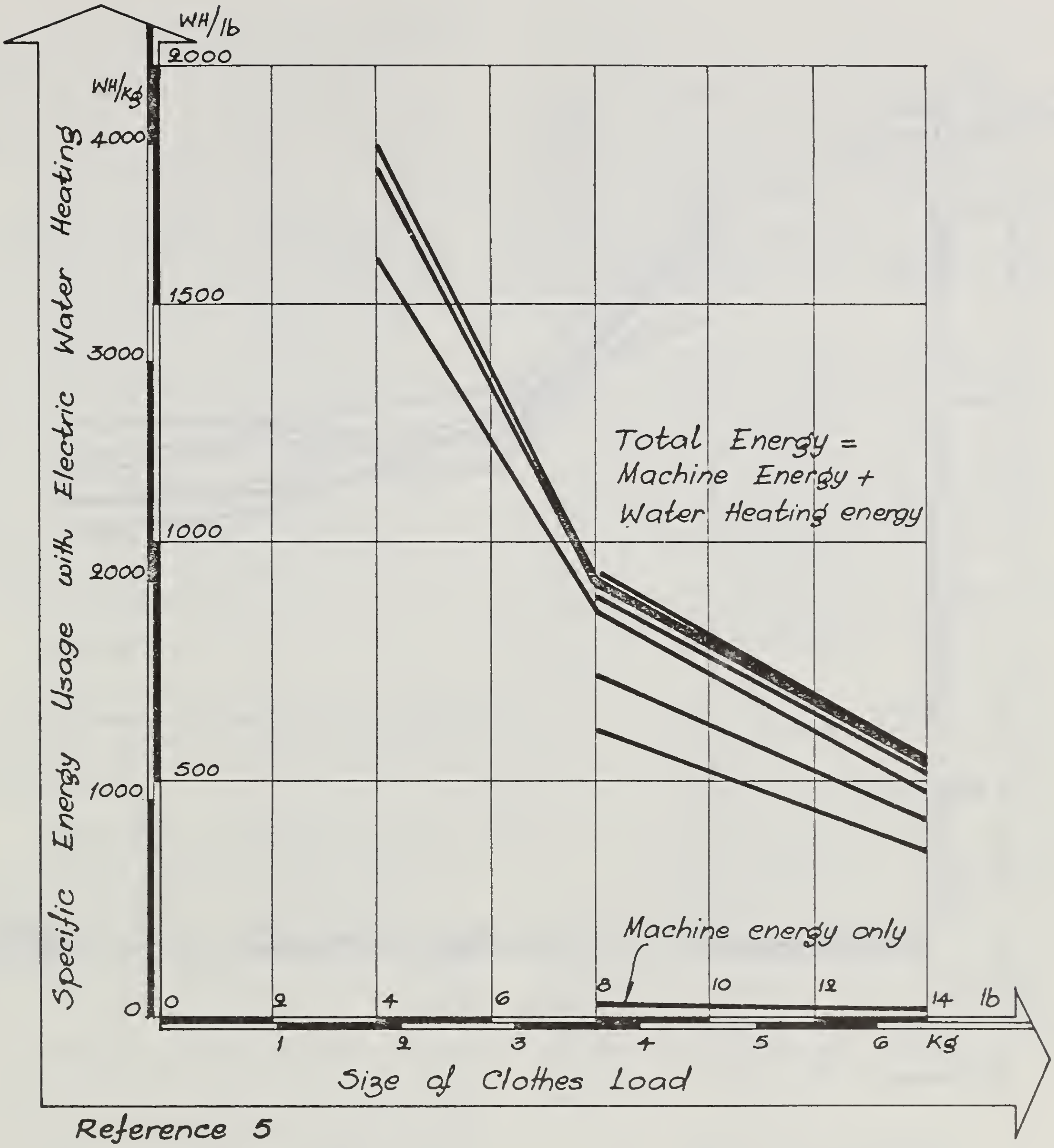
Water level is also important in the efficiency of a washer. A Proctor and Gamble study revealed that the average load size is 2.5 kg (5.4 lb) in a 6.14 kg (14 lb) washer and 2.7 kg (5.9 lb) in 7-9 kg (16-20 lb) washers.[5] At the same time 79 percent of all loads in normal size machines and 60 percent of washes in larger machines are done with the maximum water fill. This indicates the consumers' lack of awareness concerning the operating capabilities and constraints of their clothes washers.

Any measure of the actual efficiency of a washing machine should also include its efficiency in removing soils. The Association of Home Appliance Manufacturers (AHAM) specifies tests through which this ability can be compared for different machines. It should be taken into account along with energy considerations when purchasing new equipment.

Clothes Dryers

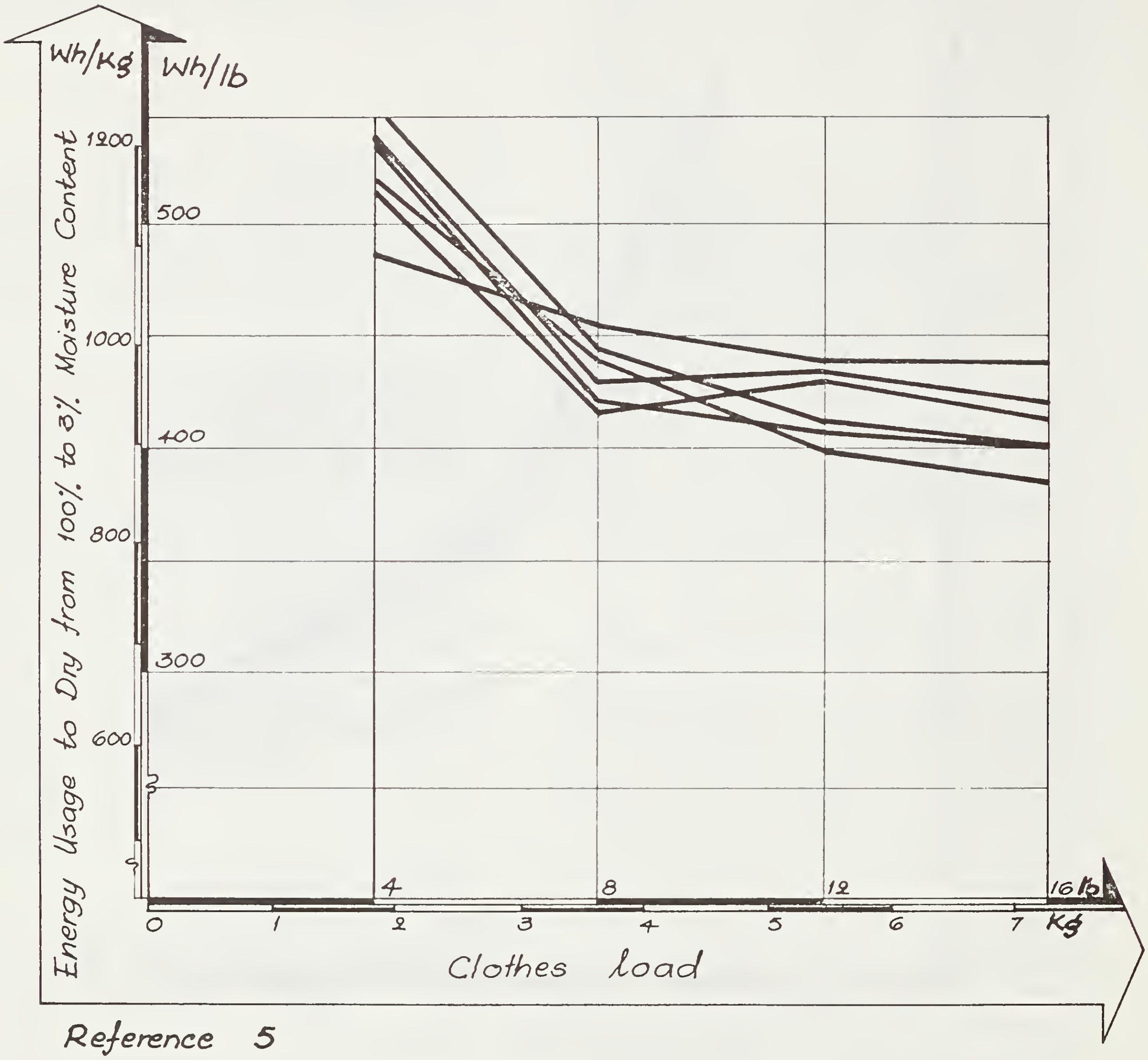
Clothes dryers represent a large portion of a typical household's appliance energy use. Similar to washers, dryers operate most efficiently when fully loaded. This is illustrated in Figure 4.6, which graphs a comparison of six competitive models of electric dryers. Operating with one-third to one-half load costs roughly 15 percent in energy efficiency.

Locating dryers in heated spaces can save 30-40 percent during winter operation. This must be traded off against heat gain to the space from the walls of the dryer and heat loss from the space through the air exhausted to the outside.



TYPICAL CLOTHES WASHERS—SPECIFIC ENERGY USE

FIGURE 4.5



TYPICAL ELECTRIC CLOTHES DRYERS— SPECIFIC ENERGY USAGE

FIGURE 4.6

From the manufacturer's vantage point, the generally acknowledged method to improve efficiency is to decrease the heat rate.[5] This results in a longer dry time, however, which may not be acceptable to some consumers.

Manufacturers can also supply automatic sensors to shut down the dryer either when a specified moisture level or exhaust temperature is achieved. (Dryers typically drop moister content from 80 percent to 3 - 5 percent.) Theoretically, automatic controls should prevent overdrying and thereby increase efficiency. It is contended, however, that some automatic controls are set too low, indicating that simple timed dryers are preferable in some cases. This control capability should be examined when purchasing a new clothes dryer.

Dishwashers

The two major uses of energy in a dishwasher are the heating of water and the dry cycle. Energy used in pumps and fans is not a significant proportion.

The volume of hot water used ranges from 45 to 61 liters (12 to 16 gallons). This can be controlled by the operator on some machines through selection of the proper wash and rinse cycle. The minimum number of cycles that will clean the dishes should always be chosen.

Temperature requirements of dishwashers often dictate the hot water temperature for the entire residence. Residential dishwashers require water at 55-60 °C (130-140 °F) while most functions need water at 38-43 °C (100-110 °F). (As mentioned above, 50 °C [122 °F] is necessary to emulsify animal fats and oils when used with detergents.) In some areas it would be economical to add a booster heater and lower the temperature of the main water heater.

Lighting

Lighting is discussed in detail in Chapter 9. However, two basic ideas concerning efficient lighting in residences will be mentioned here.

First, turn off all unneeded lights. Turning on and off fluorescent lamps, even for very short periods of time, will save energy. However, it will also shorten the life of the lamp. As an economic tradeoff between the cost of energy and new lamps, it is generally recommended that fluorescent lamps be turned off if they can be left off for 5 minutes or more.

Second, use higher efficiency light sources. Incandescent lamps, the most commonly used in residences, are the least efficient lamps available. Wherever possible they should be replaced with fluorescent lamps. Fluorescent lamps generally provide 60 to 80 lumens of light per watt while incandescent lights put out 15 to 25 lumens per watt. Fluorescent fixtures are now available in a variety of designer styles suitable for use throughout the home.

4.4 SUGGESTED ECONOMIES

A. Digest of Householder Operator Options

The suggestions in Table 4.13 are addressed primarily to the direct residential user of the various equipment. Some suggestions may apply to the owner, however. Apartment managers, home economists, architects, product design and service engineers, manufacturers' agents, governmental agencies, and educational institutions may all find these suggestions relevant.

B. Digest of Home-Owner Installation and Change Economies

The suggestions in Table 4.14 are addressed to the homeowner--or any individual interested in saving energy and expense either personally or for the occupants. Some of the ideas apply to present equipment, some to replacements, and some to structural accessories and installation. The major savings relate to space conditioning, where generally the objective of these changes is to reduce heat transfer outward in

Reduce Use of Equipment	Reduce Losses	Substitutions for Same Function	Maintenance and Prevention	Reduce Connected Load and Other
		Space Heating or Cooling		
Turn heater thermostat to 20°C (68°F) in day, to 15°C (60°F) at night, (4% day, 6% night) Set AC thermostat to 26°C(78°F) (15% fuel) Operate A/C only when needed Modify clothing to accommodate to wider comfort limits (2%) Use openable windows to cool (3%) Reduce attic ventilation in winter (maintain acceptable humidity limit) (1%) Maintain a constant thermostat setting (<1%)	Install and use shades, drapes, awnings, louvers, on south, west (2%) Keep leaking down around windows, doors, fireplace (3%) Use storm windows or tack on clear plastic sheet (3%) Where glass area is large add a second pane (3%) Use light color drapes facing outward (<1%) Use shrubs, vines outside as shades for sunlight (2%) Insulate floor of attic (1%) Shut off pilot lights in summer when away (1%)	Use ventilating fans where appropriate, particularly for kitchens or laundry	Keep filters cleaned regularly (<1%)	Shut off unused rooms and spaces (3%)
		Refrigeration Freezing		
Pre-cool heated foods prior to loading in refrigerator/freezer (2%) Remove no more ice cubes than needed (<1%)	Reduce door openings to minimum (5%) Be sure refrigerator is not against hot walls, or insert a sheet of fiberboard and an extra air space (2%)		Keep rear coils (heat exchanger) clean (<1%) Make sure door gaskets close tightly all around, replace if torn (1%)	Check actual need for the use of your second refrigerator (8%)

DIGEST OF HOUSEHOLDER OPERATIONAL OPTIONS

TABLE 4.13

Reduce Use of Equipment	Reduce Losses	Substitutions for Same Function	Maintenance and Prevention	Reduce Connected Load and Other
Empty refrigerator, leave off and open for vaction (2%) Set thermostat to keep food at 4-5°C (39-41°F) (ref.) or -17°C to 12°C (0°-10°F) (3%) (freezer)			Make sure interior lamp extinguishes when door closes (push door switch with finger) (2%)	
		Water Heater		
Set thermostat to 49°C (120°F) (10%) Don't wash dishes under running hot water; run dishwasher only when fully loaded, or wash by hand	If water heater is located in a cold cubicle, add fiber sheet, or other insulation (10-20%) Check leaky hot water faucets (& pipes) (1%)	Wash clothes in cold water with cold-water soap (4% fuel) Use lower flow shower heads (5%)	Check flame adjustment annually, if gas (1%) Add pipe insulation, if convenient (3%) Check and repair heater insulation (1%)	
		Lighting		
Turn off lights when not used (signs: "last out-lights out") (15%) Concentrate light in reading and work areas; cut general room lighting (5%) Remember heat from lights adds to the A/C load (1%)	Where possible, use fluorescent lamps in place of incandescent (40 W vs 100 W) (15%) Use one large bulb in place of several small ones (e.g., 100 W vs 2-60 W) (1%) Turn off outside night lamps during day (<1%)	Use sunlight at periphery of house (2%) Light colored walls and ceilings, reflective screens reduce the need for artificial lighting (2%)	Replace fluorescent tubes as soon as they begin "blinking" (<1%) Keep lamps and fixtures clean (<1%) Reconnect large areas so as to be served by more than one switch (2%)	In clusters, remove one bulb permanently (3%) Remove lamps used for decorative purposes only (3%)

TABLE 4.13

Reduce Use of Equipment	Reduce Losses	Substitutions for Same Function	Maintenance and Prevention	Reduce Connected Load and Other
		Cooking and Related Appliances		
Use all-oven-cooked meals (3%) Use oven self-cleaning option sparingly (2%) Plug in counter-top roasting appliances only as long as cooking (<1%) Turn down heat when pot bubbles (<1%) Turn off heater several minutes before food is done (1%) Use a single small appliance (e.g., casserole cooker) in place of a larger device (2%)	Cover the pans; use pans that cover the heating element (<1%) Permit the cooking appliance to heat the kitchen, as a consequence of its use; vent the range in the summer to reduce A/C load (1%) Do not pre-heat oven more than 2-3 minutes (<1%) Do not use range to heat the house (<1%) Pre-scrape dishes to permit use of short cycle (<1%)	Use hand mixing, etc., where appropriate (<1%)	Keep pans flat bottomed for electric heating units (<1%) Keep range exhaust filter clean (<1%) Check whether a defective appliance is at end of useful life (<1%) If gas, check setting for blue-flame; adjust pilots (<1%)	Plan use of heavy load appliances before 8 a.m. or after 6 p.m. when possible (e.g. vacuum clean or iron up a batch on week-ends)
		Laundry and Dishwasher		
Use washers with full loads of mixed sizes of articles ($3/bill) Where available use "suds-saver" (1%) Use dryer only with load that has gone through a full spinout cycle of washer (2%)	Match detergent to the water hardness, save rinses (<1%) Open dishwasher door for air drying after last rinse (1%) Use only the number of cycle portions necessary (e.g., skip soak cycles) (<1%) Avoid over drying (<1%)	Dry clothes on rack or outdoors, when suitable (2%) Hand wash single items (<1%)	Keep water and air filters cleaned out (<1%)	Run machines at off-peak times, such as before 8 a.m. and after 6 p.m.

TABLE 4.13

Reduce Use of Equipment	Reduce Losses	Substitutions for Same Function	Maintenance and Prevention	Reduce Connected Load and Other
Set dryer times for proper time and temperature (2%) Partially dry clothes, fold and place on dryer during next load (2%)				
		TV, Radio and Other Appliances		
Keep sets off except when actually attended (1%) Watch swimming pool pump and heater for unnecessary use (1%)	Unplug "instant-on" TV sets when not in use (3%) Check percolator, electric blankets, and heating pads when not in use (1%) Turn off shop tools, etc., when not in use (<1%)	Use Small Screen TV sets where possible (1%) Develop other forms of family home entertainment (2%)	Keep cutting edges sharp for motorized tools (<1%)	

Notes: ( ) indicates % savings of energy used for sector or function indicated.
<1% means less than 1%

TABLE 4.13

	Reduce Losses	Reduce Connected Load
Space Heating/Cooling		
For moderate winters	Insulate ceilings 6", walls 3-1/2" Weatherstrip, caulk windows, add storm windows or double panes Add wind screens for west and north doorways	Replace inefficient heaters, boilers, air-conditioners with new properly sized units (get quotations from experts) Select system with lowest life cycle cost
For severe winters/ summers	Insulate ceilings 9", walls 3-1/2" Add entrance vestibules for doors Plant deciduous trees or shrubs on south and west side for shade Use light colored roofing for reflection Use reflectively coated double panes interchangeable between summer/winter	Buy air conditioners with maximum Energy Efficiency Ratio rating (from the nameplate): $E.E.R. = \frac{BTU/hr\ cooling}{KW\ required}$ Use experts for installation, test, and operating instructions Install new or replacement equipment considering ambient temperatures, duct and pipe runs, thermostat locations, possible room isolation, etc.
On new homes	Limit windowed area to 10% of floor area In cold climates, minimize windows to the north, vice versa for hot climates Maximize use of natural light Permit windows to use natural ventilation Insulate heating/ cooling pipes and ducts	
Water Heating	Add exterior shell insulation Add a tempering tank if exceptionally cold intake water	Select size for lowest life cycle cost (electricity vs. gas?)
Lighting	Review lamps in each fixture so as to meet actual need Use high reflectance (80-90%) ceiling finishes, medium reflectance finishes for walls (40-60%)	Disconnect decorative lighting or remove lamps Replace suitable incandescent lamps with fluorescent, as appropriate. For higher powers, consider mercury vapor or metal halide types.

SUMMARY OF INSTALLATION AND CHANGE ECONOMIES **TABLE 4.14**

winter and inward in summer.

C. Digest of Manufacturer's Potential Design Changes

This group of suggestions is for product development and the design engineers and associates. The viewpoint argued here urges the engineer to go beyond the "first-stated" product function, its immediate mechanical implementation, and the concentration on lowest "first cost." Clearly, manufacturing energy depends upon design choices of materials and processes. Also, life cycle energy usage (and expected cost) can complicate both the designer's and the consumer's choices. Certain companies are voluntarily moving toward life cycle costing. Industry associations and regulatory agencies are cooperating in taking the first steps in this direction (see Appendix D).

Major impacts in energy reduction (see also Chapter 2) lie along the avenues of:

- extending the life of the product 25 to 50 percent and improving efficiency;
- providing maximum access for wear-out parts (belts, lamps, gaskets);
- replacing disposable items with reusable ones, whenever economical (filters);
- specifying materials which can be recycled or are biodegradable;
- considering the maintenance of manufacturing machinery during product design (i.e., extend tool life);
- designing for optimum scrap salvage, when possible (ferrous versus non-ferrous); and,
- increasing use of standardized components and accessories.

The Federal Energy Administration appliance efficiency program has replaced the NBS voluntary program which established targets for efficiency improvements in major appliances. These may be seen in Table 4.15. Industry in general considers that these goals can be achieved though there is some fear that sales may suffer.

4.5 POTENTIAL ENERGY SAVINGS

As in Chapters 2 and 3, potential savings have been categorized as *immediate*, *near-term* (2-5 yr), or *long-term* (5-25 yr). The main areas for saving residential energy are space conditioning, water heating, cooking, refrigeration, and lighting.

Space conditioning (heating and cooling) accounted for 60 percent of residential energy use in the 1973-74 base year. Table 4.16 illustrates the potential improvement possible in existing houses; over a 2 to 16 year period the total change is approximately 30 percent. For new construction, the impact of proposed new federal, state and private performance standards is as significant as the technological options and must not be ignored (see Appendix D). Other possible technological changes are solar heating and heat pumps. Heat pumps could lead to a net increase of electricity for heating purposes.

In the short term, water heating losses could be reduced in several ways; for example by design of more efficient equipment and by insulating tanks and pipes. In the long-term the possibility exists for using recovered heat or solar energy for water heating. Lighting could be improved immediately by development of consumer-acceptable fluorescent lamps for homes; with proper design this could have application both in retrofitting existing residences and in new construction, with an ultimate potential for reducing lighting electricity use by 50 percent.

New purchases of major equipment must be evaluated on a life cycle cost basis to obtain the maximum of the above benefits.

In round numbers 1973-74 energy use in the residential sector was 1.5×10^{10} GJ/year (1.4×10^{10} MBtu/year). Based on the information

APPLIANCE CATEGORY	FEDERAL REGISTER PUBLICATION DATE		ENERGY EFFICIENCY MEASURE			INDUSTRY GOAL IN PERCENT	
	Proposed	Final	Title	Abbrev.	Units	Reduction in Consumption	Increase in Measure
Room Air Conditioners	6/3/75	--	Energy Efficiency Ratio	EER	Btu/Wh	22	28.2
Electric Clothes Driers	7/9/75	--	Energy Factor	EF	STL/kWh	6	6.4
Gas Clothes Dryers	7/9/75	--	Energy Factor	EF	STL/T	12	13.6
Clothes Washers	7/10/75	--	Energy Factor	EF	STL/kWh	10	11.1
Dishwashers	7/10/75	--	Energy Factor	EF	STL/kWh	18	22.0
Electric Ranges	7/9/75	--	Range Thermal Efficiency	E_t	%	10	11.1
Gas Ranges	7/10/75	--	Range Thermal Efficiency	E_t	%	30	42.9
Freezers	6/23/75	--	Energy Factor	EF	$ft^3/(kWh/d)$	25	33.3
Refrigerators & Combination Refrigerator Freezers	6/23/75	--	Energy Factor	EF	$ft^3/(kWh/d)$	30	42.9
Color Television Receivers	7/8/75	--	Receiver Energy Efficiency	REE	%	42	72.4
Monochrome Television Receivers	7/8/75	--	Receiver Energy Efficiency	REE	%	48	92.3
Electric Water Heaters	6/23/75	--	Tank Efficiency	E_t	%	9	9.9
Gas Water Heaters	6/23/75[a]	--	Tank Efficiency	E_t	%	25	33.3

[a]Correction published 7/10/75

NBS APPLIANCE EFFICIENCY PROGRAM STATUS REPORT

TABLE 4.15

Source of Savings	Action Required	Probable Saving/Unit	% Units Applicable	Assumed % Compliance	Percent Savings Per Year	Percent Savings Total
1. Reduce conduction convection a. Insulation	Insulate ceiling, crawl spaces & improve insulation where marginal	15%	50	80	1.5	6.0
b. Convection	Storm windows, weather strip doors, seal cracks.	10%	50	80	1.0	4.0
2. Heating plant a. Heating System	Install more efficient heating system, p.e. switch operated electric starter, insulate ducts, etc.	10%	70	80	0.3	3.0 (10 yrs.)
b. Maintenance & Repair	Maintain & repair heating systems, clean filters, etc.	15%	70	80	4.2	8.4
3. Personal & family habits a. Temperature reduction	Lower temperature 1+° during day; 10° during night.	4-5% for day; 6% for night	Day 100% Night 60%	80 80	2.0 1.4	4.0 2.8
4. Other Habits	a. Handling blinds & drapes in unoccupied rooms b. Closing dampers when fireplace is not used. c. Closed door discipline. d. Other conservation measures.	6%	8	80	1.8	3.6

Reference 9

PRE-1974 HOMES: POSSIBLE REDUCTIONS IN ENERGY REQUIRED FOR SPACE HEATING

TABLE 4.16

presented in the chapter and in the case studies, the possible range of savings due to increased energy use efficiency can be estimated. For the year 2000, annual savings in the range of 25 to 45 percent (total energy) and 25 to 45 percent (electricity) appear economically and technically feasible. (See Table 4.17 for a breakdown of these estimates.)

These values are similar to other published data. For example, a US government study indicates short-, mid-, and long-term savings in the residential/commercial sector of 10 percent, 14 percent, and 30 percent respectively.[8]

As has been noted in Chapters 2 and 3, there are several events which could affect these potential savings. Perhaps most significant is the prospect of a shift of use based on some other energy form (fuel oil or natural gas, for example) to electricity. Chapter 1 should be reviewed for a more complete discussion of potential savings and a possible impact on these projections of energy shifts.

* * *

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Period	Potential Savings (%) Total Energy	Electricity
• *Immediate*--Operational housekeeping changes	5-10	5-10
• *Near-Term*--Some investments and process equipment changes	10-15	5-10
• *Long-Term*--Major investments and process and equipment changes	10-20	15-25
• *Annual savings*--in the year 2000	25-45	25-45

POTENTIAL SAVINGS IN RESIDENTIAL ENERGY USE

TABLE 4.17

EXTENSION ENERGY CONSERVATION

COOPERATIVE EXTENSION SERVICE/UNIVERSITY OF GEORGIA COLLEGE OF AGRICULTURE/ATHENS

Energy Efficiency And Appliance Use

Managing your appliances with energy conservation in mind can save money. In the days of cheap energy, it may not have mattered too much whether you used the best methods, but times have changed.

Choosing and Using Energy-Saving Models

Are you in the market for a new appliance? Buy the most energy-efficient model you can afford. Some appliances, like refrigerators and room air conditioners, are rated for energy. Others will be later. Appliances that use heat expend more energy than those with motors. Dishwashers have motors and may also boost the temperature of hot water. Clothes washers have motors but use hot water heated by another appliance. In addition, a dishwasher has a heating element for drying.

*To make your appliance energy-efficient, read and follow the manufacturer's instructions—not your own judgment.

**Plan* your work and do it with an overall rather than a piecemeal approach.

Range

Prepare a *whole* meal on only one part of the range: either the oven, broiler, or one surface unit or burner. Cook one-dish and oven meals in utensils that fit the amount of food and the units or burners. These containers should have flat bottoms, straight sides, and tight-fitting lids. Don't raise lids and let heat escape. Monitor your cooking with a clock instead.

Start surface cooking on high or medium heat, depending on the recipe and utensil. On a gas range, adjust the flame to fit the size of the bottom of the pan being used. As soon as boiling starts, adjust the heat to the lowest setting that will maintain the cooking process. Some cooktops have an automatic, thermostatically controlled top burner or unit which can do this for you.

Keep your range spotless. Clean drip pans used under electric surface units reflect more heat into the utensils than do dirty ones. Gas top burners need cleaning or adjusting when the flame shows traces of yellow. They can be removed for cleaning.

Standard Oven

Don't preheat the oven except for biscuits or cornbread. Even soufflés bake satisfactorily when started in a cold oven. Avoid oven peeking; instead, rely on the timer or clock. Because of heavier insulation, a self-cleaning oven cooks with less energy than a non-self-cleaning oven. Try to start the cleaning cycle soon after cooking a meal, so the oven has a head start on reaching the cleaning temperature. "Continuous-clean" ovens clean while cooking and do not require extra energy. However, they will not remove spillovers, which must be cleaned manually.

Microwave Oven

A microwave oven uses less energy than a conventional electric oven. But how much power you save is determined by the kinds and amounts of food you cook, as well as by your habits. Using a microwave only for snacks and defrosting isn't very efficient.

Small Kitchen Appliances

Small appliances with motors, like mixers and blenders, require very little energy. Those that heat, such as coffeemakers, toasters, toaster ovens and skillets, use an average of 1,000 to 1,500 watts. Preparing toast and coffee is more economical in a coffeemaker and toaster than on the range. Toaster ovens and skillets are thermostatically controlled and can be used instead of the range for many foods. These small appliances are limited only by their size.

Refrigerator and Freezer

A refrigerator or freezer operates at peak efficiency when filled to capacity but not overloaded.

Install the appliance away from heat sources. A 15-cu. ft., frost-free model uses about 24% more energy at 90° room temperature than at 70°.

It's important to leave air space around the appliance, especially near the condenser coils. If they aren't on the back, they are underneath, and air reaches them through a grill at the lower front. Check your instruction book before cleaning the coils.

Keep door gaskets in good condition to prevent cold air from escaping.

Don't let food block air vents.

Frost-free models use more energy than do manual-defrost models. Remove frost from manual-defrost models when the ice gets to be a quarter-inch thick. Frost insulates and makes it harder for the freezer to remove heated air.

Recommended temperature for a freezer is 0°; for a refrigerator between 38° and 40°. If you go away for a few days, raise the refrigerator setting slightly to compensate for the cold air that won't be lost while you're away.

Know what you're looking for before you open the door. Let one opening do for several.

Dishwasher

Load dishes correctly and carefully so you won't waste space or interfere with the washing action. Put soiled dishes in the machine as they are used. Keep the dishwasher door closed to maintain moisture. Wash only when there is a full load, and be sure to choose the right cleaning cycle.

A dishwasher uses about 13 gallons of hot water per load. The water should have a temperature of at least 140° to wash thoroughly and remove bacteria.

You can save half the power used for a normal load by air drying. Unless you have a model with a special cycle, do this by stopping the dishwasher, as it reaches the drying part of the cycle. The dishes will dry faster if you open the door slightly.

In the Laundry

Washer

If possible, locate laundry appliances near the water heater.

Select the correct wash cycle for the type load and amount of soil. Match the water level to the size of the load. Washing longer than necessary wastes energy and can cause soil to redeposit on the clothes.

Use warm or cold water for washing, when possible, but do not try to wash everything in cold water all the time. Most fibers need warm water to come clean. White cottons and linens need a hot water wash. All loads can be rinsed in cold water.

Soak heavily soiled garments before washing to shorten wash time. When possible, use high-speed spin in order to shorten drying time.

Dryer

Sort clothes by fiber and thickness, so heavy things will not cause lighter articles to overdry.

Make it a practice to clean the lint filter before each use. A clogged filter can cause the dryer to run too long and waste energy.

Don't overdry. Dried clothes should feel slightly cool. To avoid ironing, take garments out of the dryer as soon as they have finished. Use the no-heat setting to fluff and freshen dried articles.

Iron

Use the washer and dryer correctly to prevent wrinkling and eliminate ironing.

Buy clothes and household articles that require little or no ironing.

Do you often use your iron for pressing clothes that require a low thermostat setting? While the iron is warm, press as many garments as you can instead of heating it to do one thing at a time.

Keep your iron in good condition. Add water to your steam iron after it has heated for a minute or so. Pour the water out while the iron is still hot.

Don't use an extension cord. If the cord won't reach, move the ironing board.

Home Entertainment

Stereos, radios, and television sets use more energy than you might think. Make it a habit to turn them off when no one is listening or watching. Average radio wattage is about 70 watts.

Expect an increase in your electric bill when you change from a black and white to a color television set. The increase will be less if you switch from a black and white tube model to a color, solid state model. Here is a breakdown of average set wattages:

Color Set, Tube Model	300 W.
Color Set, Solid State	200 W.
Black and White, Tube Model	160 W.
Black and White, Solid State	55 W.

Miscellaneous Facts

*Blow hair dryers use more energy than bonnet models. They take less time but are generally used more often and require four times as much energy.

*Sleeping under an electric blanket enables you to turn the heat down and use less energy.

*Regular use of a vacuum cleaner and floor polisher amounts to about 5 KWH per month.

*With the exception of a portable heater, most other small appliances use very little energy.

General Hints

1. Set a thermostatically controlled appliance at the specified setting and leave it there until you have finished using it.

2. Be sure to use any appliance, especially if it heats, on an adequate circuit. An overloaded circuit may cause a fuse to blow or circuit breaker to trip. In any case, it will reduce voltage and cause the appliance to operate longer than normal. A circuit controlled by a 15-ampere fuse or circuit breaker will sustain 1725 watts without overloading. One with a 20-ampere fuse will support 2200 watts without overloading.

3. Do not use an extension cord unless absolutely necessary. It may cause a voltage drop with the results just mentioned. Use a heavy-duty cord if you must use one.

4. Keep your appliances in good condition. They will be less efficient when dirty or in poor working order.

5. Read the instructions with every appliance. A new one may be quite different from an older one it has replaced.

6. Sometimes the nameplate gives volts and amperes instead of watts. To get watts simply multiply volts times amperes.

Prepared by Doris Oglesby, Extension Home Economist.

Grateful appreciation is expressed to the Georgia Department of Energy Resources for contributions made toward the printing of this material.

H & E 1-2

Miscellaneous Publication 61 **April, 1978**

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, the University of Georgia College of Agriculture and the U.S. Department of Agriculture cooperating.
Tal C. DuVall, Director

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ENERGY $

REFRIGERATOR/FREEZER

Store food in smallest container possible to speed cooling.

Cover high-water content food, such as cooked vegetables, fruits, etc., to prevent frost buildup.

Cool cooked foods quickly before placing in refrigerator.

Defrost refrigerator when frost buildup is less than ¼-inch thick.

Use cold or warm water to assist in defrosting refrigerator/freezer rather than hot water.

During party time, place ice cubes in ice bucket rather than opening the door each time ice is needed.

Check refrigerator/freezer door seal for leak. Replace seal if necessary. The door seal may be checked by placing a dollar bill between the seal (the face of the door) and the door opening. If the dollar bill is difficult to pull out, then it can be assumed that the seal is good.

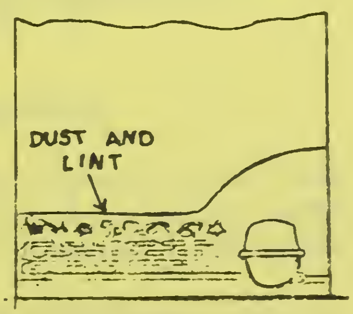
Plan meal preparation to minimize refrigerator/freezer door openings.

Do not overload refrigerator—allow for good air circulation.

Reduce temperature of the freezer to normal setting after food has been frozen.

Home freezers use less electricity when completely filled rather than when half full.

Clean the refrigerator/freezer condenser coil at least once a year with vacuum cleaner or broom.



Inefficient Condenser

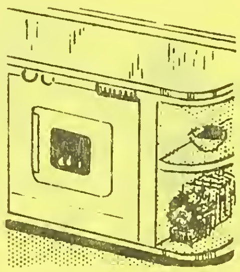
At the warmest location in refrigerator, maintain a safe temperature of at least 40 degrees F.

Place refrigerator/freezer in a cool, dry location. Allow for air circulation around the equipment.

DISHWASHING

Run dishwasher only when completely full, even if it takes several days to fill it.

Use recommended dishwasher detergent (low sudsing).



Operate dishwasher during off-peak electrical and water heating period, not while electric range and clothes washer are in use. A good time might be early in the morning or late in the evening.

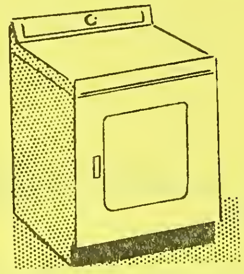
When washing dishes by hand, place dishes in the rack and rinse all at the same time, or dip one at a time in a pan of hot water.

LAUNDRY

Wait until you have a full load of the same fabrics, colors, etc. If smaller load is washed, set water selector for small load.

Use correct amount and type detergent to avoid extra rinses.

Temperature of wash water may be reduced for some items. If you have doubts concerning bacteria and germs, use a sanitizer in the wash water. Several sanitizers may be purchased in the market. Pine oil disinfectant, a liquid chlorine bleach, and phenolic disinfectant are a few.



Don't overdry clothes. It's difficult to remove wrinkles and also uses additional energy.

Cleaning the filters after each use will reduce drying time.

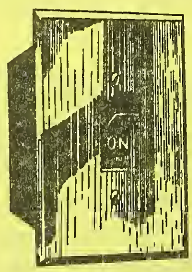
Line dry some articles when possible.

LIGHTING

Use natural light whenever possible.

Place lamps only where they are needed.

Dust light bulbs. Collected dust cuts down on light from the bulb.

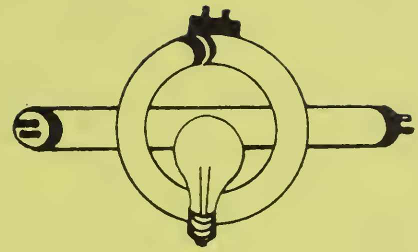


Wall switch.

Where possible, use fluorescent lights instead of incandescent lights. Fluorescent lights use energy three times more efficiently than incandescent lights.

A 40-watt, cool white fluorescent bulb produces 3,150 lumens (light output) as compared to a 150-watt inside-frosted incandescent bulb producing 2,880 lumens.

Turn off fluorescent lights only if they will not be needed for a period of two hours. It takes considerable energy to turn these lights on, and each time shortens the life of the tube.



Turn off incandescent lights if you are leaving the room for more than 15 to 30 minutes.

Use low wattage bulbs for hall and entrance fixtures.

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The Arkansas Story

Report Number 1 in Owens-Corning's Series of reports on energy conservation ideas to build on.

1

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Report Number 1. The Arkansas Story.

Two 1200 square foot homes in Benton Arkansas, using two-ton heat pumps and built to new energy conserving standards averaged only $10.74 per month for heating and cooling during 1975 according to meter readings provided by The Arkansas Power and Light Company. Utility rates at that time were 2¢ per KWH for heating and 2.5¢ per KWH for cooling.

According to Mr. Fred Clark, Manager of Technical Services for the Arkansas Power and Light Company, had these homes been constructed to conventional minimum property standards, the monthly average heating and cooling cost would have been $30.85, so it appears these new Energy Conserving Homes are saving their home owners about 65% in heating and cooling[1] compared to conventional MPS homes.

Mr. Harry Tschumi developed the original specifications for heat pump conditioned homes so that he was able to promote a program of guaranteed costs and guaranteed performance on homes as early as 1960.

In 1961 the late Les Blades of Arkansas Power and Light worked with Tschumi on an extensive program of heat transfer tests using thermocouples on both energy conserving and MPS houses. From this data, Les Blades developed a new Table of Heat Transfer Factors which provided more accurate load calculations. This enabled Tschumi to more accurately specify the right capacity heating and cooling systems, thereby providing home owners with the minimum sized equipment that would provide the greatest comfort and energy economy.

It was not until 1974 and the energy crisis that the concept gained broader recognition. Mr. Frank Holtzclaw, construction design analyst for HUD's Little Rock office was looking for a way to provide homes that would cost less to build and less to operate so more people could afford to buy homes of their own. Arkansas Power and Light put him in touch with Mr. Tschumi.

Using the years of test data, developed earlier, Mr. Holtzclaw redesigned the house to permit the installation of more insulation while saving framing lumber and construction time to reduce building costs. He did this by utilizing post and beam construction, a conventional and economical construction system long neglected in home building. This Energy Conserving Home is living up to its promise: providing greater comfort while reducing construction and operating costs.

[1]For updated report see page 40 .

In early February 1976 in New York, Mr. Tschumi, Mr. Holtzclaw and the late Les Blades, were recognized for this contribution to the construction industry as Construction's "Men of the Year" by Engineering News Record. Recently, both Jules Bergman of ABC and Walter Kronkite of CBS told the nation about the Arkansas Energy Conserving Homes on their evening news programs.

Since Owens-Corning published the first edition of this report in August 1975 and started presenting the story to home builders' meetings, over 200 more of these homes have been built in Arkansas. "As far as I know" reports Fred Clark, Arkansas Power and Light Company, "we have 200 satisfied home owners."

Information programs supporting this concept by The American Plywood Association,, The American Wood Council, National Forest Products Association, The National Lumber and Building Material Dealers Association, North American Wholesale Lumber Association, local utilities, state energy offices, and local HUD/FHA and VA offices are now active across the country.

National Plans Service of Elmhurst, Illinois, and The Plan Shop of Jackson, Mississippi, have developed energy conserving house plans and specifications for the use of builders and home buyers.

"Just as people demanded lower MPG (miles per gallon) cars, they are now beginning to demand lower cost per month homes" advises Mr. R. E. Trumbull, vice-president and manager, Insulation Marketing Division, Owens-Corning Fiberglas. "Arkansas Power and Light and Owens-Corning have filled requests for information from over 2500 prospective home buyers."

"Insulation is cheaper than oil, and a recent survey of home buyers by The Professional Builder showed that 89% were willing to spend $600 more in construction to save $100 per year in fuel bills. These Arkansas homes have shown that savings in excess of $200 per year can be achieved with little if any increase in construction costs" It appears that the energy conserving home is a concept whose time has come.

This is the Arkansas Story.

Owens-Corning was not a participant in the development of Arkansas energy conservation home demonstration project, and we are, therefore, doubly grateful to the participants, both for the energy saving concepts they have introduced and for providing the information and allowing us to tell their story.

Owens-Corning Fiberglas Corporation

A service to home builders...

One original idea inspires another. Through "Ideas To Build On" we hope to challenge your ingenuity in developing or adapting ideas that will make new homes more comfortable and attractive while reducing energy consumption and costs for home buyers.

This is the first of a series of reports highlighting unusual energy conservation techniques being developed by builders and others around the country. The ideas, being new, may challenge commonly accepted axioms and long established building codes, so you will find the hardest part of pioneering is persuading others to accept your new concepts.

Should you have a new and better home construction idea that will help the industry sell homes, or save fuel and favorably effect our nation's balance of trade, we hope you will test it out. The home building industry needs leaders just as the country needs homes that people can afford to buy and maintain. If you can demonstrate that your idea works, let us know and we will be glad to consider publicizing your energy conservation house or concept in this series of "Ideas To Build On.."

Our main purpose is to provide a service to home builders. We hope you will find the series informative and useful.

Note: Wherever the expressions FHA, MPS or "Conventional Homes" are used in this report, they refer to homes built with 2" x 4" studs 16" o.c. insulated with 6" Blown Insulation (R-13.2) in the ceiling, 3½" R-11 batts in the walls and 1" perimeter insulation around the slab. For comparative heat loss and gain calculations, it has been assumed that these homes had a window area of 128 sq. ft. of single pane glass, 10.67% of gross floor area, vs. 64 sq. ft. of glass, 5.33% of gross floor area, for the Energy Conserving House. These are both within HUD requirements of 10% of bedroom, living room and dining room living area. Exterior doors were 1-3/4" hollow core with storm doors. The houses had gable louvers without soffit vents.

THE ARKANSAS STORY

A study in building energy conserving homes

E X E C U T I V E   S U M M A R Y :

F A C I N G   R E A L I T Y

The Arkansas Story...A Demonstration in Energy Conserving Home Construction.

With the competitive desire and need to keep the cost of homes as low as possible, the home building industry has, until recently, had little incentive to inform prospective customers of the fact that heating and cooling savings for the life of the mortgage exceed the cost of preventing much of the energy loss. While low construction cost is still important, reduced energy consumption and costs have become essential to the nation and a marketable home benefit for the builder.[1]

Today, in many parts of the country, utility costs are exceeding the home owner's monthly mortgage payments. The home buying public is well aware of the importance of a well insulated energy conserving home.

Homeowners and renters are already protesting loudly at today's increases in energy costs which at this point are averaging 40-80%[2] above 1973. If homes continue to be built to conventional pre-energy-crisis low insulation standards and energy costs continue rising beyond 1985, it is a question if home owners will be able to afford their home heating and cooling costs by the turn of the century. The energy conserving home provides the answer.

[1]House and Home, May, 1975 quotes Whit Ward, Secretary-Treasurer of Ward Properties in Tampa, Florida, as saying that...Tenants are increasingly sophisticated about the costs of energy. His firm can even use as a marketing strategy the quality of insulation in a complex because over the last six months tenants have begun to ask detailed questions about it.

[2]Based on oil and gas. Electricity increased an average 38%.

WHY THE HOME WAS DEVELOPED

In Little Rock, Arkansas, an air conditioning engineer dedicated to making heat pumps provide economy as well as comfort, asked for the help of an electric utility, interested in adding customers to utilize existing capacity.

Ten years later, a HUD construction analyst with innovative ideas in construction and a desire to provide homes that low to middle income families could afford, utilized the concepts and data gathered to design an energy conserving house. This home cost no more to build than the same size conventional house built to FHA minimum property standards. Forty-one percent of the conventional framing was eliminated by post and beam construction, the use of a modified truss system bearing on 2" x 6" studs spaced 24" on centers with single bottom and top plates and plywood headers. Non-load-bearing inside partitions utilized 2" x 3" studs 24" on centers with no headers and single plates. In addition, steps were taken to prevent as much infiltration as possible, window areas were reduced, the windows double glazed and shaded. Construction changes outlined in this report, have, according to two builders, enabled them to cut house construction time by seven days.[3]

Between 1974 and the middle of 1975, thirty-five electrically heated and cooled homes, most of them three bedrooms, two baths, 1040 to 1200 square foot in area, were built. Ten of these were each equipped with two meters so heating and cooling use could be measured separately from lighting and other use. The target: annual heat pump heating and cooling costs under $10 per month. Two larger 1200 square foot homes in Benton, Arkansas have a full year's metering, with actual heating and cooling costing $10.74 per month. So the target was basically achieved.

Recently, the concept has spread to 41 other states where more than 200 builders have reported they are building or plan to build more than 5,000 of these energy conserving homes this year.

Homeowners vouch for their greater comfort and the quietness of these energy conserving homes.

Owens-Corning Fiberglas has been asked for the facts by many of its customers. This is what we found out. This is the Arkansas Story.

[3]Trend Homes, Arkansas and Brandes and Roy, Inc., Hartford, Connecticut.

The Savings provided by the Arkansas Energy Conservation Design.

When reports came out of Little Rock that homes were being heated and cooled for about $130 annually, many of Owens-Corning's customers were incredulous and started asking our representatives if it was true and if so, how could such savings be accomplished.

As of March 1, 1976, the following one year's metered heating and cooling costs[1] on four homes have been reported from Arkansas:

House Size Sq. Ft.	Size Heat Pump	6 months Htg. Cost	6 months Clng. Cost	Total 12 Month Cost
1200	1½ ton	73.26	70.15	143.41
1200	2 ton	34.98	76.25	111.23
1200	2 ton	54.68	91.73	146.41
1344	1½ ton	42.38	96.32	138.70

Within a few months, a full year's electricity usage on six additional homes will become available. The average annual heating and cooling costs for these four energy saving homes averages 10.9¢ per square foot. Which, at the same rates would be 38.2¢ per square foot for the comparable MPS (Minimum Property Standard) homes. Compared to the MPS homes (based on assumptions shown on page 42) there appears to have been a 73.6% savings in energy for heating and cooling and there was an average cost reduction for total energy use of 46.7%.

In support of national energy conservation and as a service to those involved in designing, constructing, selling or buying new homes Owens-Corning is publishing this report on how these energy and cost savings are being accomplished in Arkansas.

This report, based on interviews with the engineers, builders, contractors, a realtor and homeowners, is designed to collate the necessary information in one place and explain the many departures from standard practice. These energy conserving changes were made desirable by recent increases in energy cost and the forecasts for continuing increases. As a result, the major emphasis in home building has changed from achieving low construction costs to lowering the long term operating costs and energy consumption. The Arkansas concept, however, provides, a means of saving energy without necessarily increasing construction costs.

[1]Based on 2¢ for heating and 2½¢ for cooling for comparative purposes see page 40 .

The basic heating and cooling of these homes has been with electrical heat pumps or, on the smaller homes, requiring one ton or less, where small enough heat pumps are not available, an electric furnace and compressor. On larger homes, other energy sources can be utilized and savings achieved providing capacity does not exceed loads. Resistance type heating in the ceiling or baseboard was not used, despite its low initial cost because it raises the effective surface temperature and does not provide the continuous slow air flow, humidity control and air cleaning necessary for ideal comfort.

When these houses were built, Tschumi was unable to find commercially available fossil fuel heating units of small enough capacity to provide the desired continuous low heat operation necessary to comfort and economy... in other words, for these 1200 sq. ft. homes in Little Rock, units with a bonnet capacity of 15,000 to 18,000 BTUH.

Whatever the energy source, heating equipment should be sized to run with minimum cycling and temperature variation and with continuous fan operation.

If flame-type heating and/or water heating is used in a house built to these standards, the firing unit must either be installed outside the conditioned space or be provided with adequate outside air through 6 inch or larger ducts to prevent fumes being sucked into the living area by the turning on of vent fans such as those installed in the bathrooms, in the clothes dryer, or over the stove."

It is the responsibility of the builder to obtain expert advice and specifications before installing any fossil fuel equipment in or attached to the house. This also applies to fireplaces. While these are not recommended in an energy conserving home, it is recognized some owners would prefer to have them and pay the cost and energy penalty.

A design for a vented fireplace by Harry Tschumi is included in this book on page 28 but it is the responsibility of the builder to have a qualified expert check that the air provided is sufficient for his particular house. The sketch is only included to indicate a possible method for air intake and venting while preventing unnecessary heat loss. Superior Fireplace and Heatalator have units designed with glass fronts that draw in outside air.

The number of occupants and pets in a home and their living habits can vary the annual heat loss and gain, so there is no way to accurately forecast consumption or savings. For example, every degree of difference in thermostat setting alone can affect energy consumption by as much as 5% to 7% and the home owner is free to save or waste energy as he chooses.

High water tables in some areas can cause through the slab heat loses in excess of standard tables. Les Blades and Harry Tschumi developed their own heat calculation charts that reflected greater heat loss through floor slabs and crawl spaces. These heat gain and loss calculations also considered physiological thermodynamics.[1] Simply explained, even though a home may be warm, if its occupants' feet feel cold, they will tend to feel chilled and raise the thermostat, which wastes energy. A recent research project by the Electricity Council Research Center, England[2] has substantiated this phenomenon.

Although the developers of the Arkansas project were unaware of this independent study, their research led to the same conclusions resulting in estimates of higher through-the-slab heat loss and gain calculations than commonly factored. This resulted in specification of higher insulation R values than conventional at that time. This is one reason why the owners of these new homes are as complimentary in talking about the comfort they are experiencing, as they are about their energy savings and costs.

The objective in Little Rock was to gain maximum control over the interior environment of the home. In other words, to isolate the interior environment from the variable exterior environment. By erecting a thicker and more continuous than usual insulation infiltration and vapor barrier they were able to provide the desired comfort and the fuel saving. What was so ingenious about the way this was accomplished was that the new design could be constructed at the same or less cost than the same size energy leaking conventional homes.[3]

[1]The heat loss or gain for walls and ceilings may be calculated based on infiltration, the difference between inside and outside air and the resistance of the total wall or ceiling. In the case of an uninsulated slab floor, however, there is almost direct contact between the person's own body heat of about 98°F and the ground temperature. If the slab is being further cooled by ground water, the chilling effect will be greater.

[2]See Research Summary Page 49

[3]See calculations on page 43

SOME BENEFITS PROVIDED BY ENERGY CONSERVATION HOME CONSTRUCTION

It is claimed that homes built to these specifications will use appreciably less heating and cooling energy than is required for conventional homes insulated to minimum property standards.

Home Buyers

The homeowner will benefit from a home which, at little or no extra cost, will provide superior sound isolation, greater comfort as well as heating and cooling costs considerably lower than comparable conventional homes.

The homeowner buying under VA/FHA insured mortgages should be able to qualify for a larger, or more expensive home based on the anticipated fuel savings. For others previously ineligible to buy a home it may enable them to qualify for a loan. Furthermore, because the heat pump provides cooling as well as heating, the FHA in Arkansas will approve mortgages for homes with this heat pump cooling if built to energy conserving standards. When it comes time to sell the home, the records showing lower utility costs should provide strong inducement for a prospective buyer to select the energy conserving home over others on the market.

Builders

These plans enable a builder to sell a more desirable home with added features at little, if any, increase in cost.[1] The fuel economy may enable many new buyers to qualify for mortgages and others to purchase larger homes with the same down payment and financial capability. The construction requires no new tools or skills. The number of parts to be assembled are fewer, construction time can be greatly reduced and a big bonus is to be gained is customer satisfaction.

Insulation Contractors

These new homes are designed to simplify insulation installation while requiring greater thicknesses for higher volume and income.

[1]See Page 43 on costs and Page 47 on buyer acceptance.

The Electric Utility Company

The added insulation delays the peak load, decreasing the generating capacity required of the utility. Because these homes make it both practical and desirable to utilize electric heating and cooling, the utility may be able to add new customers without necessarily increasing their present capacity. The more even use of power and the delayed peak use of power can reduce utility costs for everyone and make better use of our energy resources. In addition, electric utilities over the years can be adapted to consume and convert whichever fuel the nation can best afford to utilize.

EVOLUTION OF THE ENERGY CONSERVING HOME

The test homes ranged from 1040 to 1536 square feet of living area with three to four bedrooms and two full baths. The heating and cooling energy consumption was recorded on one meter. The second meter recorded the total electric consumption of each home. Heating and cooling amounted from 27% to 42% of total energy consumption in the energy conserving homes. The total averaged monthly electric costs of the test homes were about 47% less while the heating and cooling costs were between 60% and 74% less than estimated for the same size MPS homes.

Origin of the Concept

Built to new minimum construction standards for energy conservation homes issued by the Little Rock area office of HUD, and designed by Mr. Frank Holtzclaw, HUD Construction Analyst, in cooperation with the Arkansas Power and Light Company, these new homes were the culmination of 12 years of testing and experimentation.

During the late 1950's a series of research studies on owner satisfaction of conventional homes around Little Rock equipped with heat pumps indicated some were unhappy with the high energy costs and dissatisfied with the comfort provided. House by house inspection of the homes of the dissatisfied owners revealed that the problems were not due to the equipment but to insufficient or improper insulating, uninsulated ducts, construction changes after the equipment had been installed and lack of humidity control.

Mr. Harry Tschumi, now President of Harry Tschumi Company, air conditioning wholesale distributor, consulted with the late Mr. Les Blades, then heating and air conditioning coordinator for Arkansas Power and Light Company. Together they started testing the effects of changing the insulation thickness, insulating doors, using double glazed windows and measured the results. The conclusions were that a tight super insulated home with as small as practical heat pump would prove the most economical application and provide the most comfort. At that time, in the early 1960's, few home buyers or builders wanted to invest in the extra materials. Then came the fuel crisis with rocketing energy costs and a demand for lower utility costs.

Frank Holtzclaw, using the earlier findings of the late Les Blades and Harry Tschumi came up with an ingenious solution. He designed a house that used less lumber and that could be built in less time. He reported it has a safety factor in excess of 2 to 1 for load and racking (based on using commercial grade Southern Pine) which is more than acceptable strength. It is claimed this construction in Little Rock costs no more than the conventional single story, slab floor, home construction it is designed to replace.

THE SECRETS OF THE SUPER INSULATED ENERGY CONSERVING HOME

Wall Construction

The Little Rock energy conservation home is built with 6" stud walls, 24" on center. This allows for compression of 6" of fiber glass insulation in the 5½" walls.[1] But there are other design differences, too. Since the ceiling is insulated with 12" of insulation, the sheathing is attached to the vertical modified truss member, flush with the outside of the studs, all the way to the top of the insulation in the attic.

The studs in the house corners are set so one is flush to the outside sheathing and the other starting the connecting wall is at right angles 5½" from and parallel to the sheathing. It will be seen that instead of leaving an uninsulated box in each corner of the house, this permits the corner to be insulated. Similarly, where a partition meets an outside wall, because back-up clips are used, no "T's" are necessary.

These clips eliminate the need for backer boards, saving lumber and leaving room for more insulation in the outside walls. At the center bottom of each stud through which wiring is going to be passed, a hole is augered or vee cut to provide a race way. This avoids having wiring interfere with insulation installation, and saves the electrician hours of augering holes through studs.

One other major difference in wall construction is that the total window area of the house must be restricted to 8% of the gross living area. In addition, these must be insulated double pane windows or single windows with a storm window. Boxing around windows is simplified to permit more insulation to be placed in the stud space. Plywood headers replace 2" x 8's" allowing more space for insulation.[2] The single sole plate is set on a full bed of caulking.[3] The single top plate serves to tie the wall laterally.[4] The second story studs and/or modified roof trusses, also 24" on center, are required to rest on the top plate directly over the top of the studs.[5] Use is made of metal perforated tie plates at wood joints and back-up clips are used to hold the gypsum board. A polyethylene vapor barrier completely covers the inside, warm in winter, face of both studs and insulation. Foil backed gypsum may be used instead to provide this infiltration and vapor barrier. Electrical outlets are caulked or taped to the gypsum board.

Some people reviewing these specifications ask if they couldn't retain their standard 2" x 4", 16" o.c. standard wall and add 1" extruded polystyrene foam insulation as exterior sheathing with R-13 Fiberglas batts. This did not meet the Arkansas objectives of reducing costs and is not part of the Arkansas Story. One inch of extruded polystyrene and R-13 Fiberglas batts provides a through the wall R of 20.11. The Arkansas wall with R-19 batts provides an R of 21.43. The National Mineral Wool Association published a brief comparison of the different systems in the Insulation Reporter, April 1976.[6]

You will find in most parts of the country that 2" x 6" lumber in short lengths used for studs is less expensive per board foot than 2" x 4" studs. According to a lumber call out there is a saving of at least 1204 board feet of lumber in building to the Arkansas Specs for Plan 274 compared to standard MPS 2" x 4", 16" o.c. construction. This is a 1200 sq. ft. house with a 660 sq. ft. attached garage. Also, it should be possible to use 2" x 6" lumber in the No. 3 or utility grade of most species. Western Wood Products Association is also introducing a stud grade 2" x 6" for this type of construction. In Little Rock (July 1975) 2" x 6" pine utility grade studs cost $147 per thousand board feet compared to $210 for "stud" grade 2" x 4"'s. These prices may be exceptional, but nonetheless, the energy conserving home requires less lumber when compared with conventional 16" member spacing, and uses lumber at lower cost per board foot. A chart on page 47 provided by Frank Holtzclaw shows that for the Number 274 house design shown in this book, but with a single car garage, there was a 41% saving over standard 2" x 4", 16" o.c. framing. He even shows a 34% saving over 2" x 4", 24" o.c. framing because of the single, top plate, reduced headers, savings in T's and jack studs and 2" x 3" interior non-load bearing partitions in the Arkansas system.

Crawl Space and Slab Insulation

While it is true, that if sufficient temperature difference exists, hot air rises, it is also true that heat flows to colder surfaces or areas. Where walls and ceiling are well insulated, the heat will be attracted and dissipated by the coldest surface even if this is the floor.

Since people are quickly chilled if their feet feel cold, this tends to make them desire a higher thermostat setting. For both energy management and comfort, the floor areas must be maintained as close as possible to room temperature. This, it has been found in Little Rock, requires 6" of insulation over crawl spaces and a minimum of 1½ of closed cell polyurethane rigid foam insulation around the perimeter of the slab. In crawl space construction the finish grade must be fully covered with a moisture barrier and since another vapor barrier is installed above the floor insulation, the crawl space must be ventilated. There were no houses with basements in this test program, but these can be insulated using the required resistance of foam or Fiberglas insulation and furring out.

[1]This reduces insulating efficiency of the insulation from R-19 to R-18.

[2]An alternate system utilizing plywood glued and nailed every 4" in place of sheathing as a header permits the full 6" of insulation to be installed. See Page 23 .

[3]Fiberglas sill sealer has also been used effectively for this purpose, because of its thickness and compressibility it is more effective than rigid sill sealers at accomodating uneven spacing between the bottom plate and foundation wall.

[4]The plates must be cut so joints are centered over the stud and they must be joined by a tie plate.

[5]Each end of the truss is joined to the stud by a rafter anchor in Arkansas.

[6]National Mineral Wool Association, 382 Springfield Ave., Summit, N.J. 07901

C O N S T R U C T I O N

Essentials of the Arkansas Energy Conservation House

This review of the Arkansas specification for energy conservation will help you understand statements made in this report.

The purpose of the higher insulation requirements in Arkansas is to assure that wall, ceiling and floor will keep within a degree or two of the same temperature as each other. The early test homes in Arkansas demonstrated that the occupants were sensitive to minor temperature variations and feeling a difference would change their thermostat. This, particularly with a heat pump, is where energy gets wasted since a heat pump will operate every time you turn it up or down.

Does it pay to add more insulation? This cannot be answered with a "no" or "yes" until calculations are worked out for a particular house. Its size, shape, geographic location and energy rates may allow for a reduction in tonnage of heating and cooling equipment only if the additional insulation is used. In this particular case, the cost savings in equipment cost may more than compensate for the added insulation. The greater efficiency provided by a smaller unit will provide energy savings.

S P E C I F I C A T I O N S

The following minimum construction standards are at present being utilized on houses being built to the Little Rock Office of HUD and the Arkansas Power and Light Company. HUD standards for national consideration eliminate some of these elements. For example, the installation of a dehumidifier in a desert area of Nevada would be unnecessary. Items identified with a "+" symbol require regional consideration. Comments in brackets are <u>not</u> part of the HUD specification.

Insulation +

Sole plate - Sill insulation or full bed of caulking shall be installed around complete perimeter.

Concrete slab floor - 1½" Rigid Closed Cell Urethane Foam Perimeter Insulation...R-10.7

Crawl space floor - 6" Fiber Glass Friction Fit Batts...R-19[1]

Exterior walls - 6" Fiber Glass Friction Fit Batts...R-19[1]

Ceiling - Two 6" Fiber Glass Friction Fit Batts of Insulation...R-38[1]

1. Vapor Barriers:

Walls, ceilings and floors shall be provided with a positive vapor barrier covering the entire surface and having a transmission rate not exceeding one perm. (The use of polyethylene sheeting has been assumed to be more effective than vapor barriers attached to insulation because this covers the entire stud area and does not require the insulation to be compressed at edges to permit stapling flanges to inside edge of studs. Such compressed areas have a reduced R value. Foil backed drywall has been used where polyethylene has been unavailable.) Polyethylene shall be lapped 6" at all joints. Any tears or holes shall be carefully sealed with duct tape.

2. Windows:

Prime window with storm window. Prime window must be caulked in place and the spaces around should be chinked and caulked. Window area not to exceed 8% of the square footage of the living area.[a] (In Little Rock they are installing as an acceptable alternate aluminum framed double glazed insulating windows with 3/16" air space between panes. Wood frame insulated windows, or single pane wood windows with a storm window added, will provide less heat transmission.[b]) Overhanging eaves to prevent direct entry of sunlight are a necessary element of the design. Alternately any glass exposed to the sun's direct radiation shall be provided with an acceptable shading device that will block at least 70% of the sun's radiation during the cooling season.

[a]HUD regulations require window area equal to 10% of the usable living area in living room, dining room and bedrooms. One can meet this requirement but still keep total area at 8%.

[b]Windows are one of the greatest sources of heat loss and gain so it is recognized that the use of insulated wood windows with storm sash for year round use will produce greater energy savings but may increase the cost of the house.

[1]Insulation batts come in a limited number of preformed sizes and shapes and may not conform to the exact amount of insulation specified in a continuous analysis. But in this discrete case, the last available increment of insulation whose Marginal Energy Savings (MS)/Marginal Cost (MC) ratio is closest to the optimal MS/MC ratio (without falling below it) provides the optimal "feasible" solution. This feasible solution is indeed optimal for in reality the marginal cost could be quite high for an increment that would exactly meet that level determined in a continuous analysis. This is because production and distribution costs associated with a very large number of sizes would be higher than that of a limited number of sizes. (Reprinted from Building Science Series 64 by Stephen R. Petersen, National Bureau of Standards, published by the U.S. Department of Commerce in cooperation with the Federal Energy Commission.)

3. Exterior Doors:

1-3/4" metal faced doors with urethane core and magnetic weather stripping, plus weather stripped thresholds with base flashing and caulking.

4. Attic Space:

Power roof ventilators with eave vents evenly spaced along the soffits with net free air equal to 80 square inches per 100 CFM of the fan capacity. Gable louvers shall not be used. Power ventilators shall be located near roof ridge and centrally positioned in order to remove hot air throughout the attic space. Ventilators shall have a capacity to provide not less than ten air changes per hour. Thermostats shall be set to turn on at 95^{o}-100^{o} and turn off at 85^{o}F in summer.

No part of the heating and cooling equipment shall be located in the attic space. (If house design dictates that air ducts must pass through attic, ducts shall be made from 1" insulated duct board.)

5. An inspection catwalk shall be installed from the attic access opening to the extreme ends of the insulated attic space. (Two layers of half inch thick plywood across supports attached to the trusses were used in some of the demonstration houses.)

6. All wiring and piping must be installed so as to permit correct placement of insulation. In walls, wiring should be allowed to lie on the sill plate by cutting suitable notches in the base of wall studs before erection. In the attic, wiring should be attached to roof trusses at a point higher than 12" from the ceiling. (Wiring must comply with local ordinances.) Wherever wiring or piping enters or leaves stud spaces it must be fully caulked. Pipes must not be placed behind outlet or switch boxes.

7. Humidification:+

A humidifier of suitable capacity capable of providing 50% humidity at 70^{o}F shall be provided.

8. Dehumidification:+

A dehumidifier capable of maintaining humidity of 40% shall be provided. (Remember in these homes the heat pump equipment is reduced by as much as 2/3rds but there is no change in cubic footage or occupancy. The smaller heat pump will not be able to reduce the moisture fast enough by itself.) Note: The objective of the temperature and humidity controls including vapor barrier is to maintain complete control and fast response to any environmental change so that the occupant will not feel it is necessary to adjust the thermostat. With a heat pump, a change either way turns on the pump, and uses energy so the less changing the better!)

9. Filtration:

An adequate air filtering device shall be provided. An electrostatic filter is standard. (Replaceable filters are recommended on return air entry to the equipment closet during construction.)

10. Sill and Window Flashing (for brick or masonry walls):

Suitable flashing will be placed to extend from behind the sheathing down over the sill plate into the course of bricks. Similarly, suitable window flashing shall be placed over bottom window framing and door sills to drain down into mortar course of brick facing. No space shall be enclosed by two vapor barriers. (Caution should be exercised if plywood exterior sheathing or foam sheathing is being considered on the exterior, that has as good or a better vapor resistance than the interior vapor barrier. 'Above ground the exterior skin should be 4 to 5 times as vapor porous as the interior skin.' According to the University of Illinois Small Homes Council--Building Research Council PA.)

11. Wall Studs

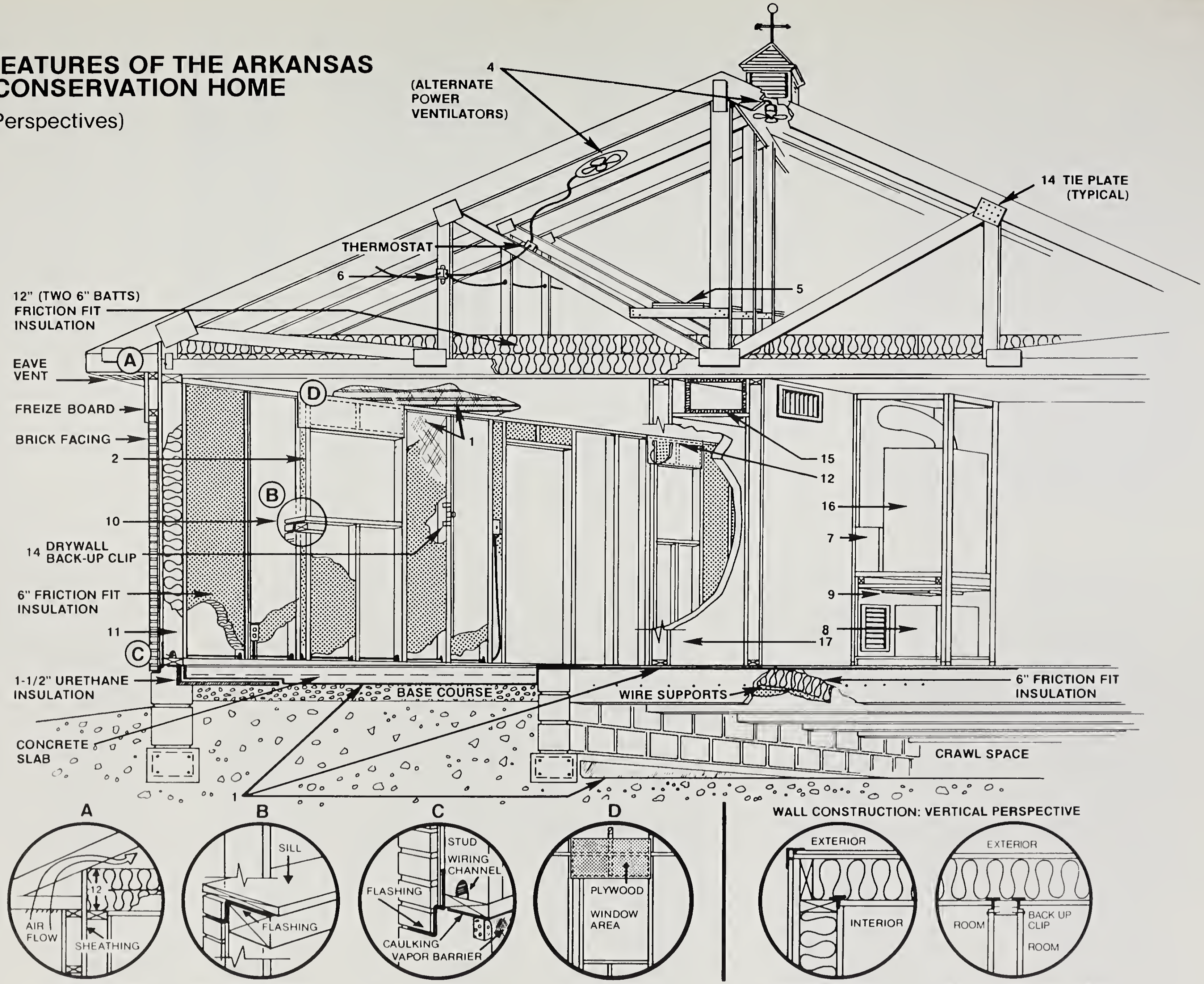
Shall be 2" x 6" spaced 24" on centers, positioned per drawings to permit all spaces to be fully insulated. (Single sole plate and single top plate. Joints must occur centered on studs, be joined with a tie plate and each be anchored to the stud over which it rests.)

12. Window Headers:

In houses up to 36' wide with a truss roof: for 48" rough openings and less, header shall be not less than ½" thick standard grade plywood nailed and glued with 8d. common nails spaced 4" along edges and intermediate members. Glue shall be elastomeric exterior glue conforming to U. S. Department of Commerce Product Standard P. S. 1-66. Plywood will be attached instead of sheathing from top of window opening to at least the center of the top plate, (ideally to just below the attic insulation level) and on either side of window opening to second stud. Face grain of plywood shall be horizontal. On larger windows, dual headers 2" x 6" or larger, shall be installed to interior and exterior of studs to provide a void between for insulation installation.

DESIGN FEATURES OF THE ARKANSAS ENERGY CONSERVATION HOME

(Illustrative Perspectives)



DETAIL AT THE EAVES CEILING INSULATION EXTENDS OVER STUD WALL TO SHEATHING

WINDOW FLASHING AS LAID OVER WINDOW FRAME DRAINING INTO BRICK MOTAR JOINT

BASE FLASHING EXTENDS FROM BEHIND SHEATHING INTO COURSE OF BRICKS.

1/2 INCH PLYWOOD HEADER GLUED AND NAILED, IN PLACE OF SHEATHING, OVER WINDOW.

POSITIONING OF CORNER STUDS TO ALLOW THE INSULATION TO FILL CORNER

NON-BEARING PARTITION JOINS THE EXTERIOR WALL

13. Structural Support:

All overhead loading must be placed directly on top of wall studs. In two story houses, windows must be placed upstairs so that direct support of studs is provided from sill to rafters on either side of window frame. Windows upstairs should be placed over windows or doors downstairs. If stud continuity is broken, extra studs should be placed either side and headers installed to provide necessary structural support.

14. Tie plates and drywall back-up clips:

Although not a requirement, the use of tie plates to join framing and back-up clips to attach drywall has been utilized in the Little Rock Experimental Homes as a cost saving measure and to reduce the number of wall studs. Where partition walls join exterior framing, the use of back up clips eliminates the need for T's. This not only saves on lumber but permits more insulation in the wall.

15. Ducts:

Although not a requirement, insulated ducts for sound absorption or lined metal ducts with flexible connections to the fan chamber have been used to reduce noise transmission. All ducts have been installed in passage ways by dropping the ceiling and along upper perimeters of interior walls. Where ducts must be placed outside of insulated living space they should have 2" of insulation or utilize prefabricated glass fiber duct. Because space is limited, only rectangular ducts should be used so they can provide adequate air flow. Sizing of ducts is important. Since the equipment size will be reduced so should the duct size be reduced proportionately.

16. Equipment placement:

Heating, cooling, and attic ventilating equipment shall be centrally located. (Containing the plumbing within a small rectangle and locating the water heater as close as practical to kitchen sink and dishwasher helps reduce heat loss from piping.)

17. Partition walls:

Since partition walls are not load bearing some may be constructed of 2" x 3" studs to regain the living area sacrificed by the thicker exterior walls.

18. Construction strength:

With the various changes in construction, the 24" spacing of 6" studs, the reduction by approximately 41% of the lumber used in the framing compared to 2" x 4" on 16" centers it is natural to wonder if the loading is soundly engineered. Mr. Frank Holtzclaw, HUD Construction Analyst in Little Rock, reports architects were commissioned to analyze the construction. Based on standard pine or fir commercial grade 2" x 6" lumber, with grain in direction indicated in drawings accompanying the specifications for a 30' wide house; with plywood corner bracing, post and beam construction, all strength requirements under load were met with a two to one safety factor--even before the addition of sheathing.

NOTE: Equipment

Too few homes have been researched to make an evaluation of any specific equipment but the efficiency and location of equipment in the home is important and should be given serious consideration by the builder. An EER rating above 7 is desirable.

For example, some trial extrapolations indicate that blower operation can cost anywhere from $12 to $70 per year so the added cost for a more efficient blower will be quickly repaid and result in considerable energy savings. Water heaters also vary in efficiency and adequacy of insulation. Because of the high heat loss of some water heaters the Little Rock developers have decided they should be kept out of the equipment room. However, a new generation of better insulated water heaters are now being introduced in the market place which may overcome this problem.

In these energy conserving homes the unit operates on a cooling cycle down to 50°F outside temperature and for more than six months of the year is cooling. Consequently, in Arkansas, the equipment and insulation are calculated on cooling needs.

S T A N D A R D S -- E N E R G Y S A V I N G

H O M E * I N L I T T L E R O C K

GENERAL: 2" x 6" studs (Utility grade, No. 3 or better), 24" on centers, single plates with joints centered on studs and joined with tie plates. Modified truss, 24" on centers centered over studs and attached to stud with anchor at each end. A scissor truss with extended legs is necessary for a cathedral ceiling. Interior, non-load bearing walls may be 2" x 3", 24" o.c. without headers over doorways. Sheathing must extend to same height as attic insulation.

INSULATION:

R-38 in Attic. Two layers of R-19 unfaced batts manufactured to stated R-value.

Attic insulation extended full thickness to outer sheathing.

Unfaced R-19 batts between 6-inch wall studs on 24-inch centers. Wiring routed along sole plate through raceway to avoid interfering with proper insulation installation.

Caulk beneath exterior sole plate.

Unfaced R-19 beneath crawl space floors. R-10 closed cell urethane foam around perimeter of slab floors and as thermal break separating porches, patios and garages from conditioned spaces.

VAPOR BARRIER:

6 Mil Polyethylene beneath slabs, or on conditioned side covering entire floor area above insulation for crawl space floors: 6 Mil polyethylene or foil-backed gypsum board on entire ceiling and exterior walls on conditioned side of insulation.

6 Mil polyethylene ground cover for crawl space floors.

WINDOWS AND EXTERIOR DOORS:

Window and door area must not exceed 10% of total floor area, by outside measurement, nor 15% for individual rooms.

Windows must have insulating glass or, storm windows with prime window caulked in place.

Storm windows in preference or in addition to insulating glass or even more desirable wood frame windows and storm windows.

Urethane core doors with magnetic weatherstrip.

Storm doors are required for doors rated less than R-7 or if windows are cut into insulated steel doors.

Shading method for windows to block 70% of the sun's radiation in summer. As much as possible, avoid placing window areas in south and west walls.

Try to avoid placing concrete patios and walkways close to house in south and west where they may reflect heat despite overhang.

ATTIC VENTILATION:

Thermostatically controlled power ventilator to give 10 air changes per hour mounted near center and near peak of roof. Evenly spaced eave vents to provide 80 square inches of free area for each 100 CEM of fan capacity. (Ridge and gable vents are not considered as equal in Arkansas.)

Thermostatic control for power vent set to turn on at 95^{o} and off at 85^{o}.

FIREPLACES:

If installed, shall be entirely within the conditioned space, have a tight fitting damper and glass screen, and have outside air introduced at the hearth. Duct size is dependent on size of fireplace. (Exterior of fireplace to be insulated).

AIR DUCTS

Rectangular metal ducts should be installed within the conditioned space, preferably lined with one inch of duct liner--or pre-fabricated glass fiber ducts may be used.

Duct loss of any ducting outside the conditioned space should not exceed 5% with all ducts within conditioned space preferred.

All joints and seams in sheet metal and in vapor barriers shall be taped or cemented.

OTHER EQUIPMENT:

Heat Pump or Electric Furnace and Air Conditioner
Electric Air Filter
Humidifier
Dehumidifier

Cooling equipment sized within 6000 BTUH of requirement at 25^{o}F. TD. No equipment to be located in attic space.

OTHER:

Catwalk above insulation for access to attic space.

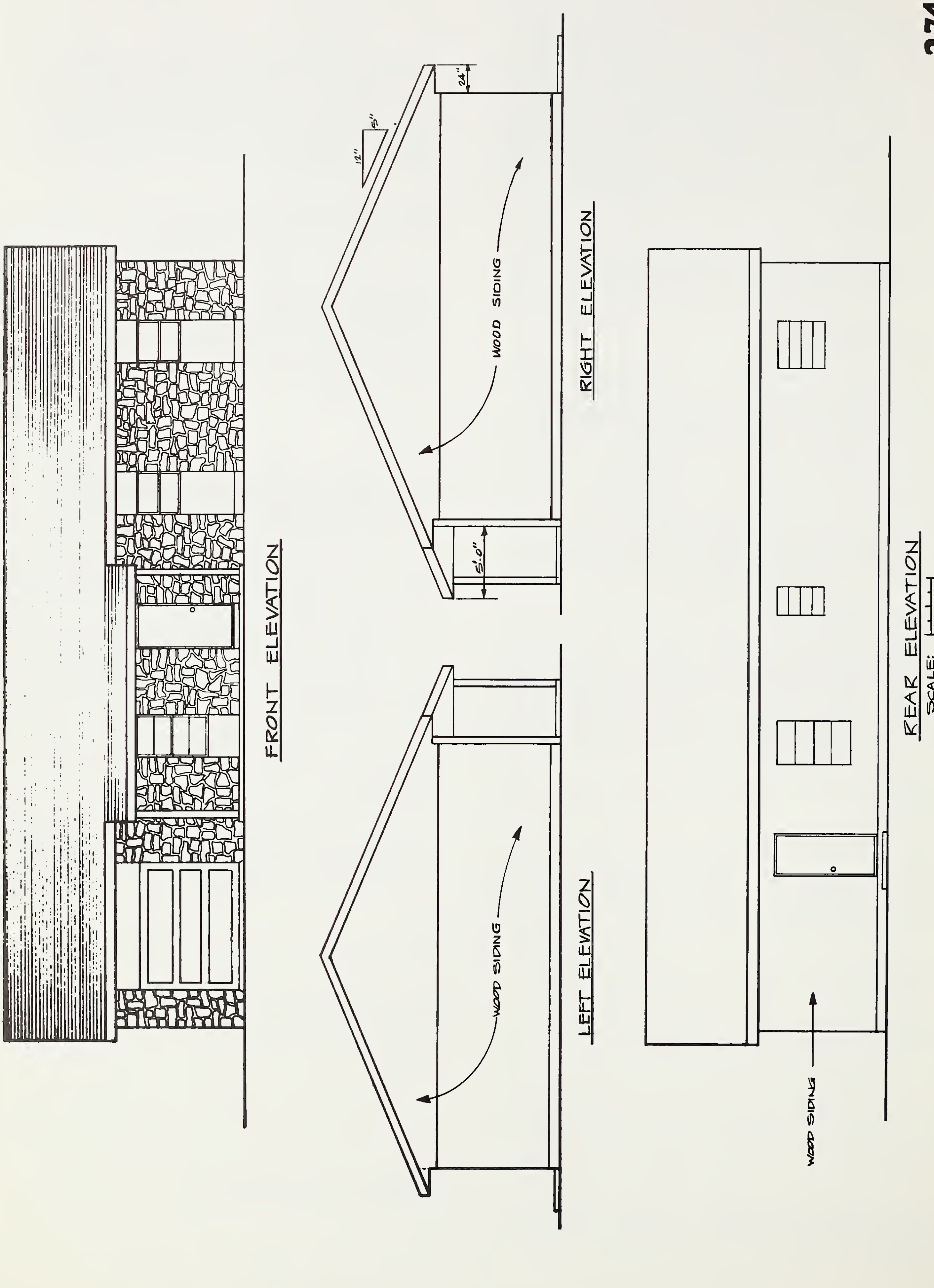
Centralized plumbing core near water heater location (or multiple water heaters if points of use are not centralized).

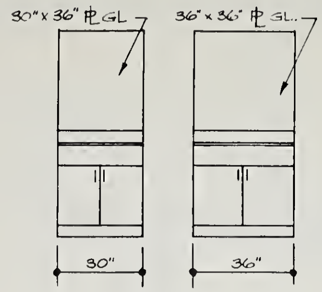
OPTIONAL:

Use of back-up clips to hang gypsum wall board.

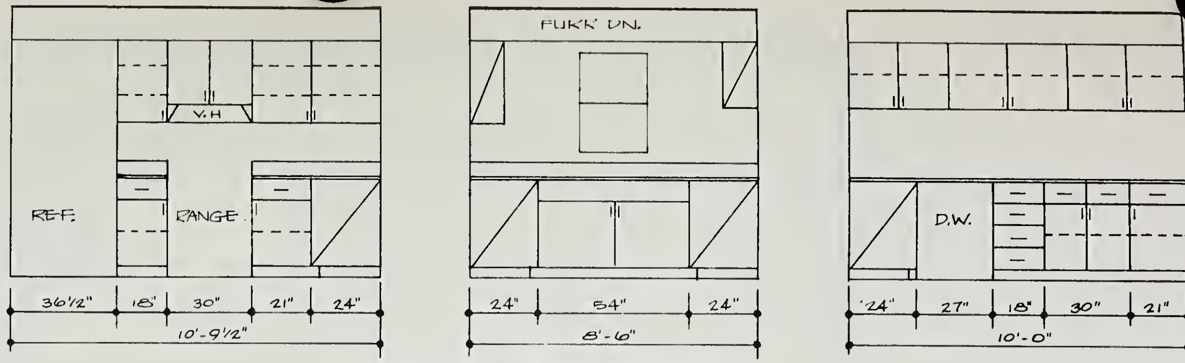
*Single story on slab based on original HUD standards in Little Rock.

274

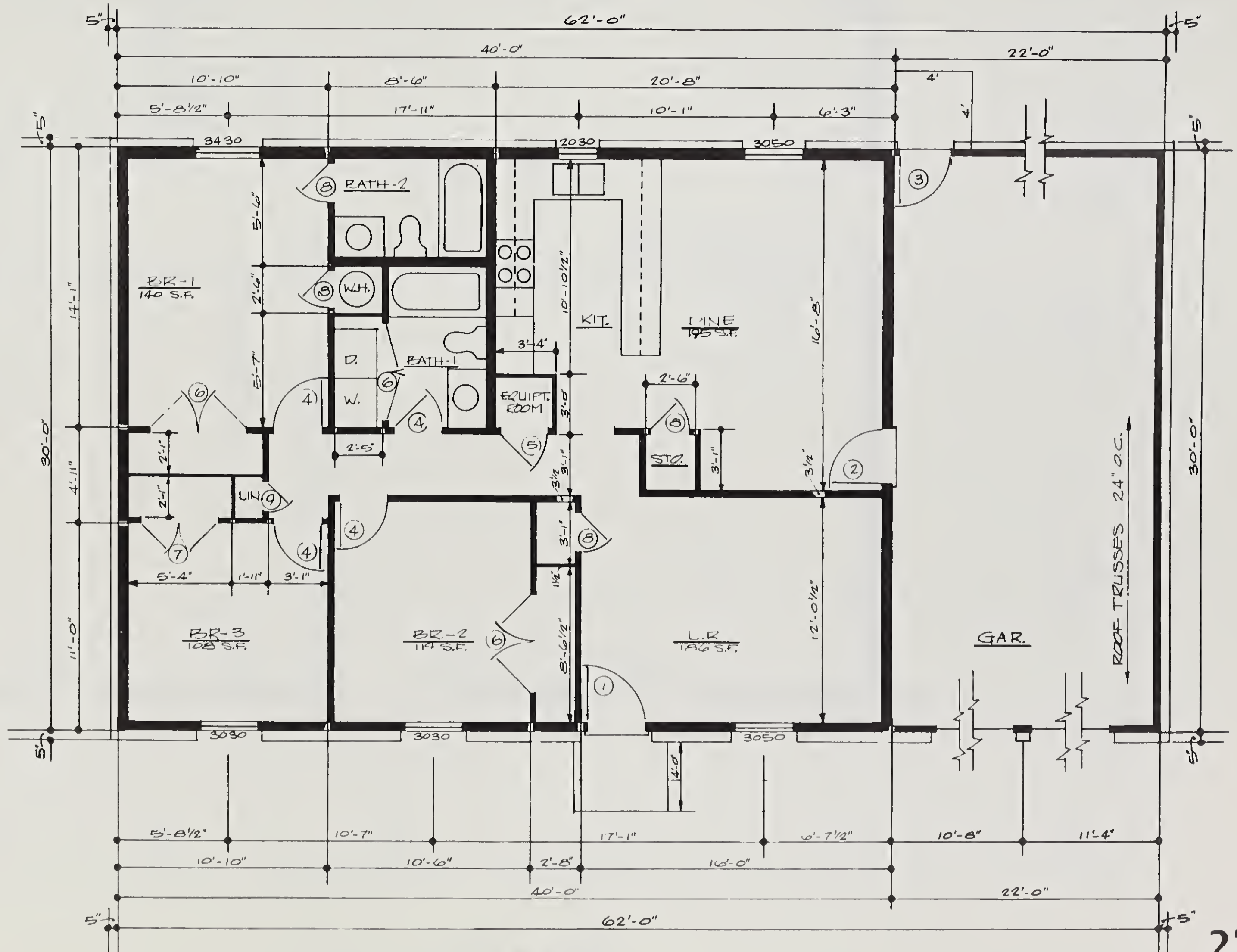

FRONT ELEVATION
RIGHT ELEVATION
12"
5"
24"
WOOD SIDING
6'-0"
LEFT ELEVATION
WOOD SIDING
REAR ELEVATION
SCALE: 4'
WOOD SIDING



VANITIES

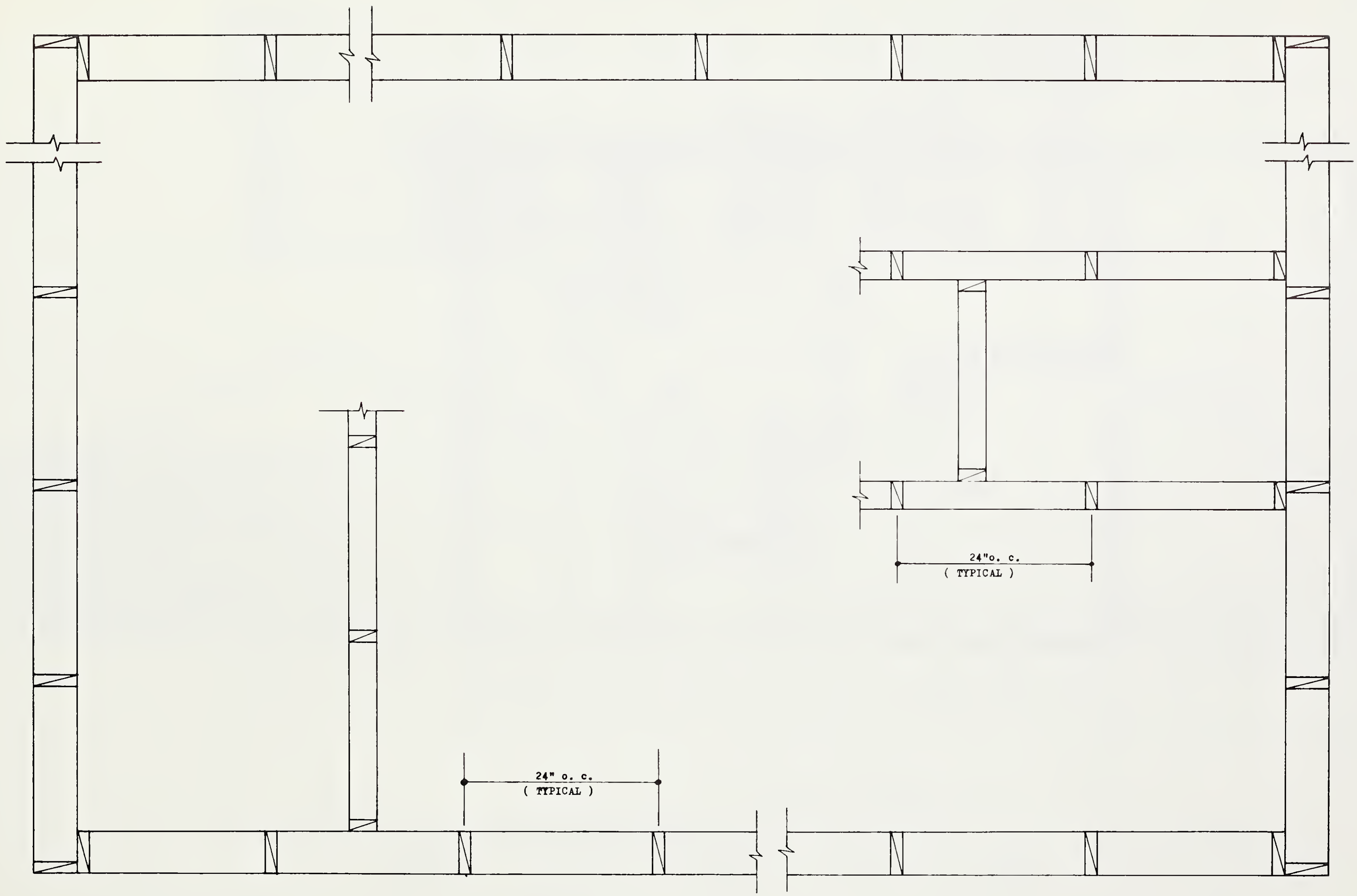


KITCHEN ELEVATIONS
SCALE: 3/8" = 1'-0"



FLOOR PLAN
SCALE: FOUR FEET

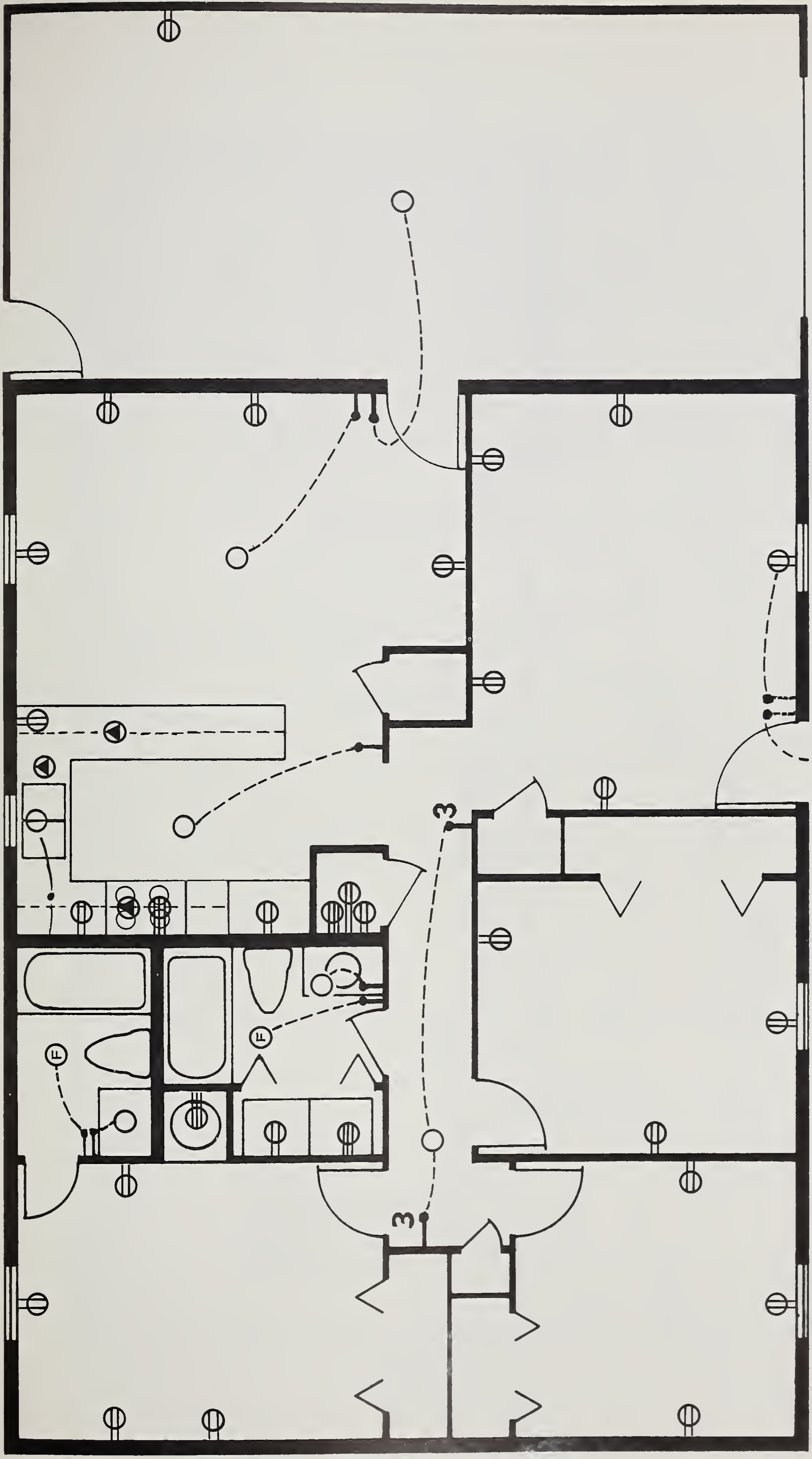
DOOR SCHEDULE	
1.	3-0 x 6-8 x 1¾" THERMA-TRU
2.	2-8 x 6-8 x 1¾" THERMA-TRU
3.	2-8 x 6-8 x 1¾" H.C. EXT.
4.	2-6 x 6-8 x 1⅜" H.C. INT.
5.	2-6 x 6-8 x 1⅜" H.C. INT. W/LOUVER
6.	2-6 x 6-8 x 1⅜" H.C. INT. PAIR
7.	2-0 x 6-8 x 1⅜" H.C. INT. PAIR
8.	2-0 x 6-8 x 1⅜" H.C. INT.
9.	1-6 x 6-8 x 1⅜" H.C. INT.
10.	9-0 x 7-0 O.H. GAR. DOOR



PLAN OF EXTERIOR AND INTERIOR WALL STUD SPACING

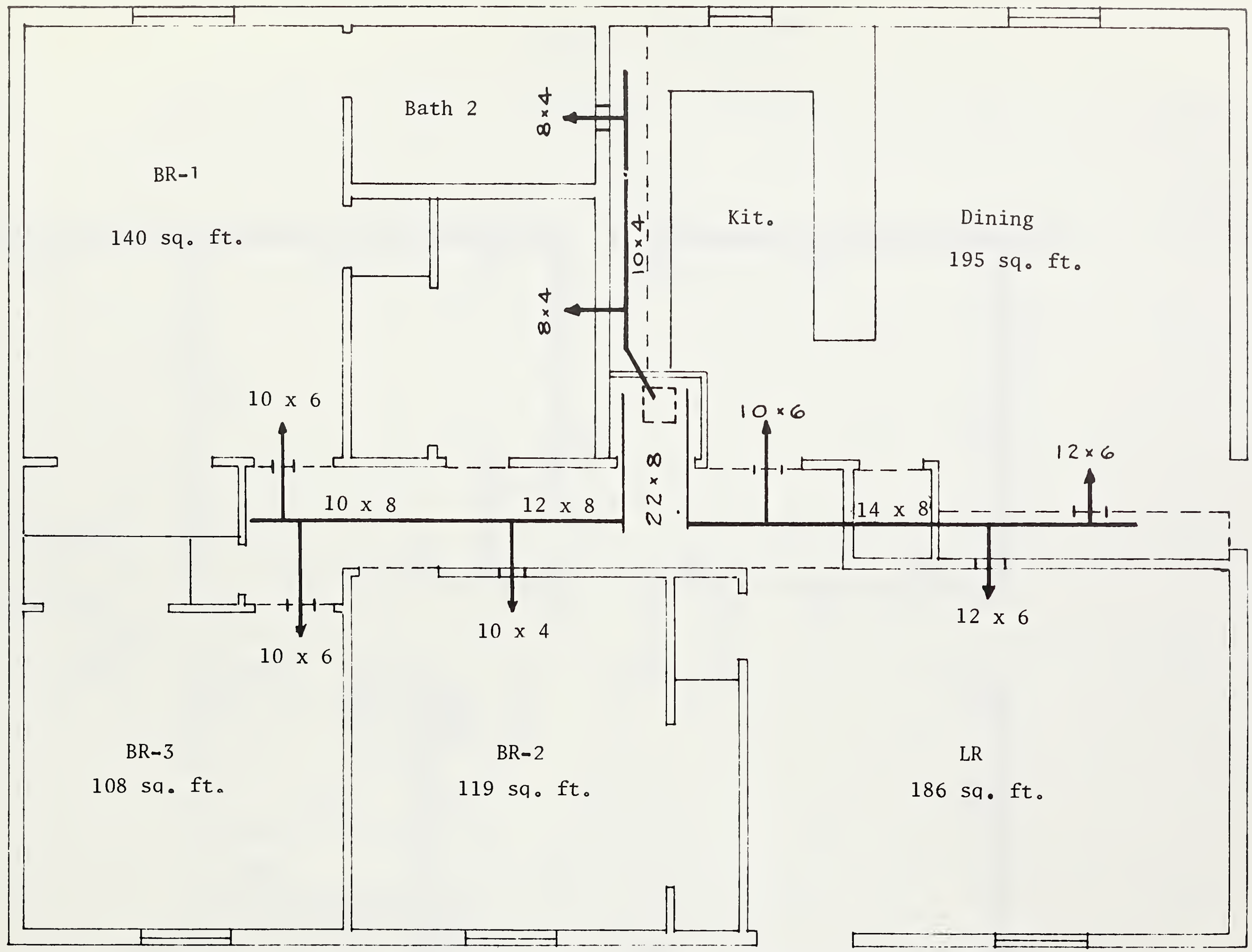
SCALE: ONE FOOT

274



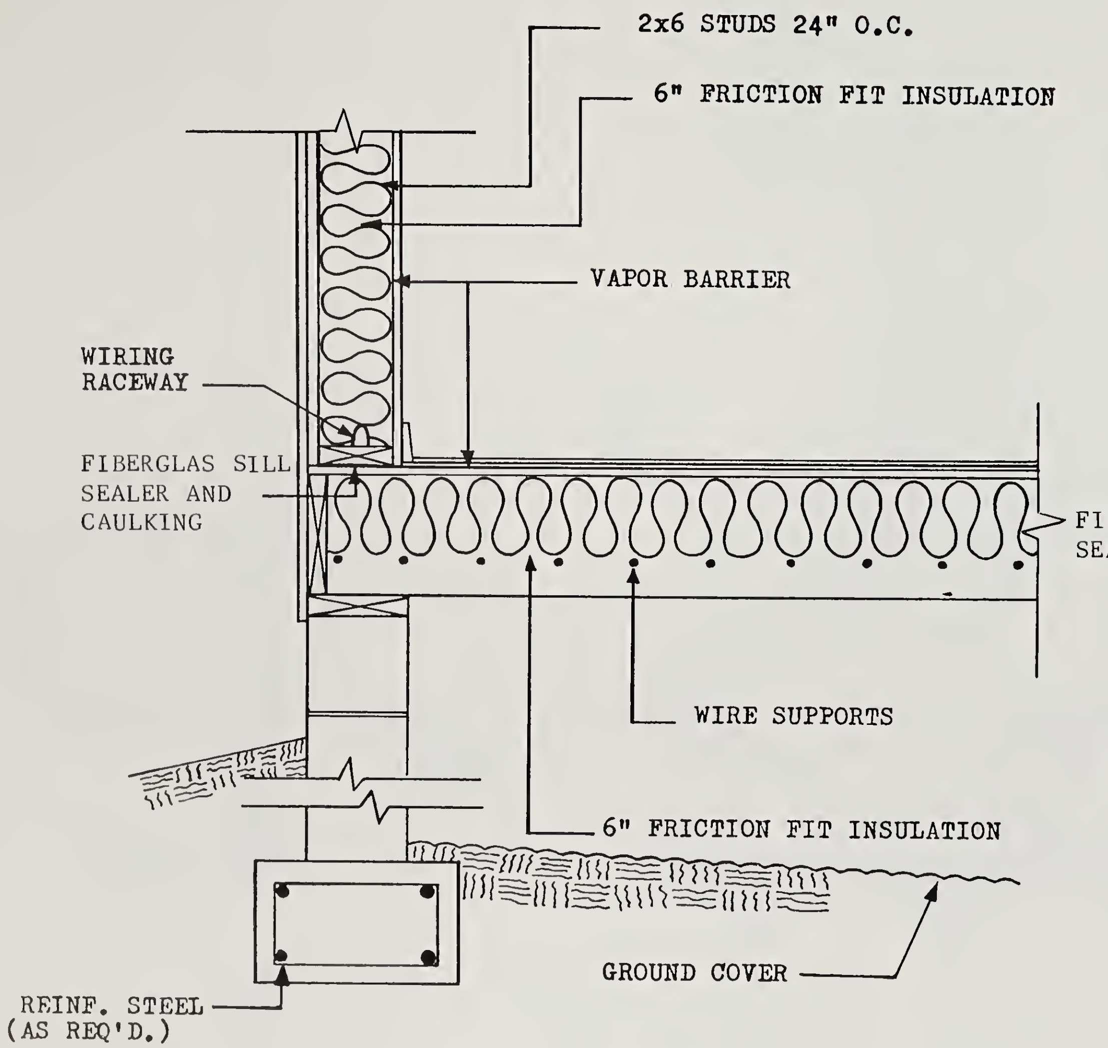
ELECTRICAL LAYOUT

SCALE: FOUR FEET

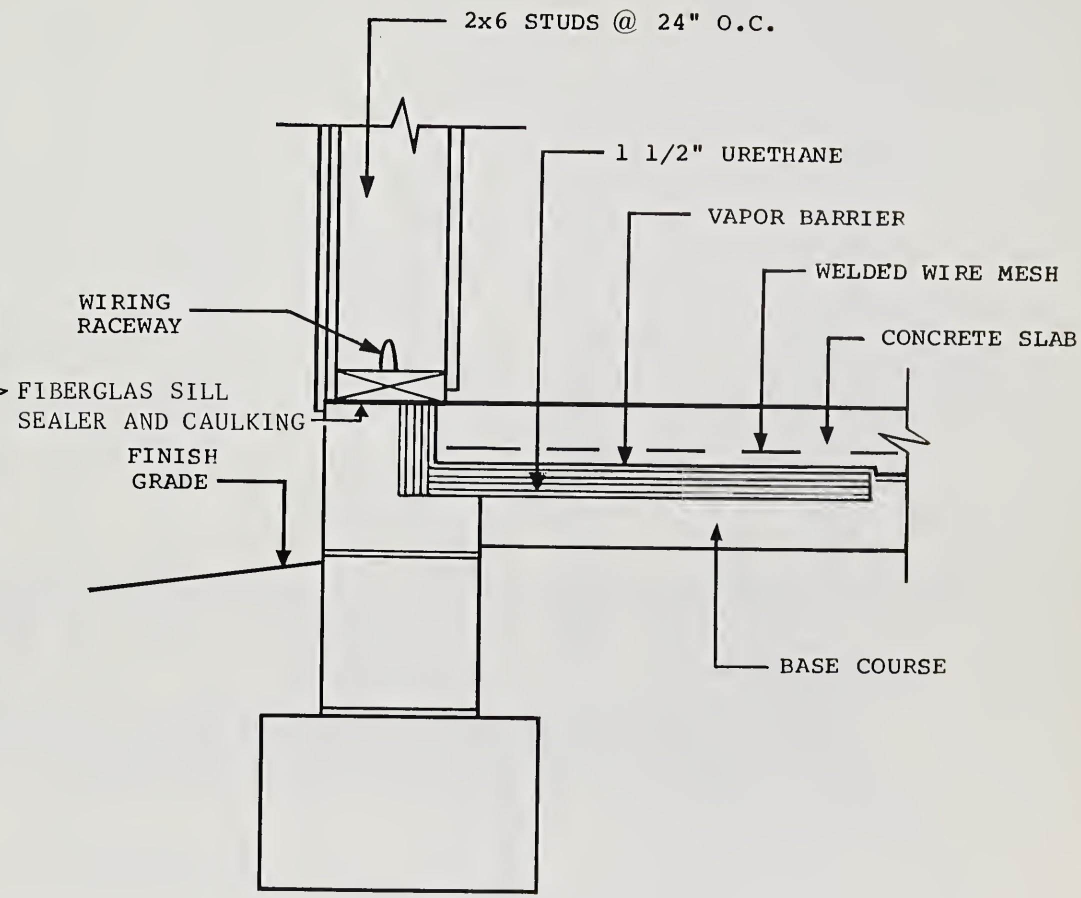


Sizes shown are for one inch lined metal ducts (Fiber glass duct board ducts can be used). Diffusers shown are double directional with volumetric control.

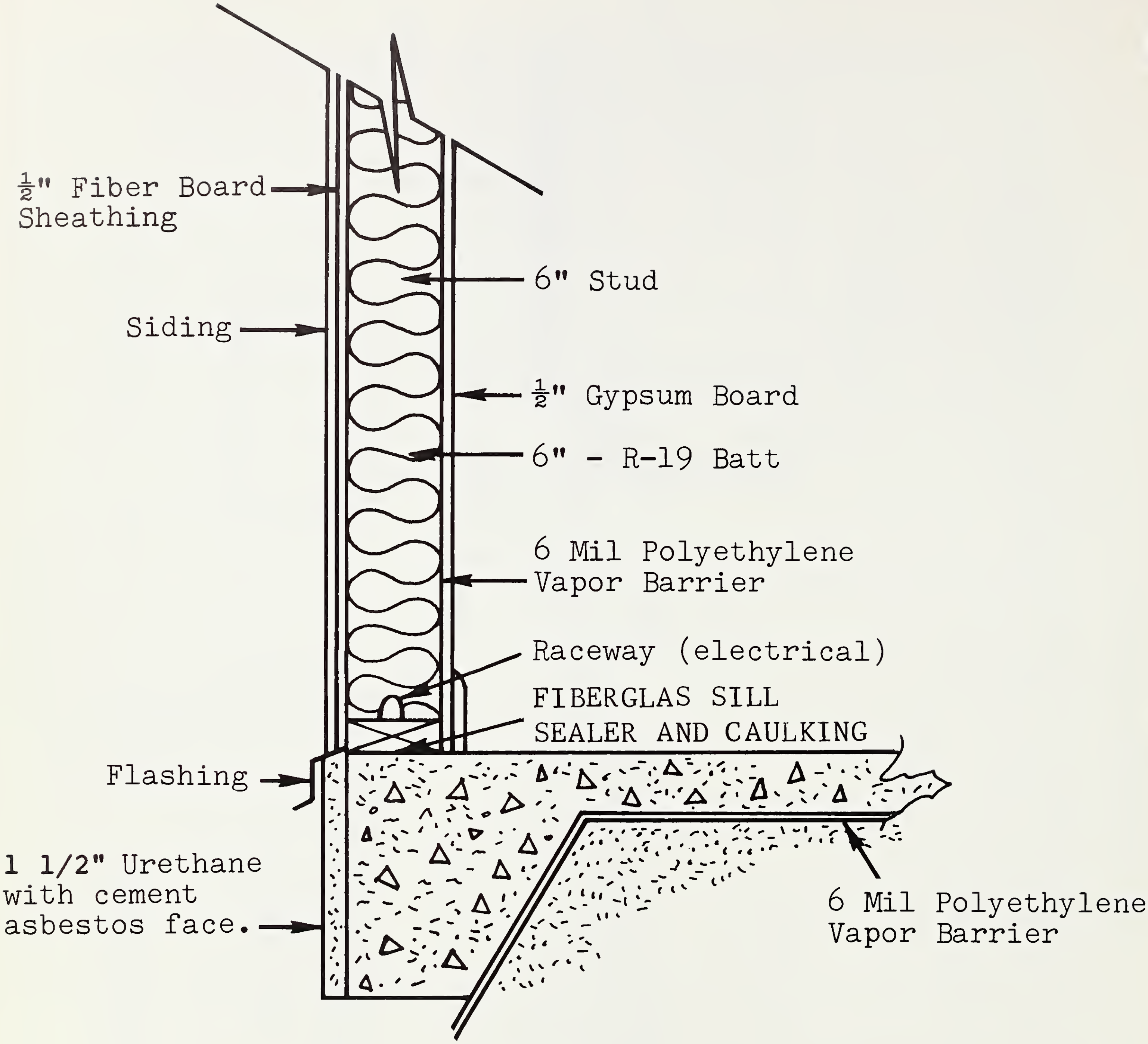
AIR CONDITIONING LAYOUT



CRAWL SPACE CONSTRUCTION (INSULATION)



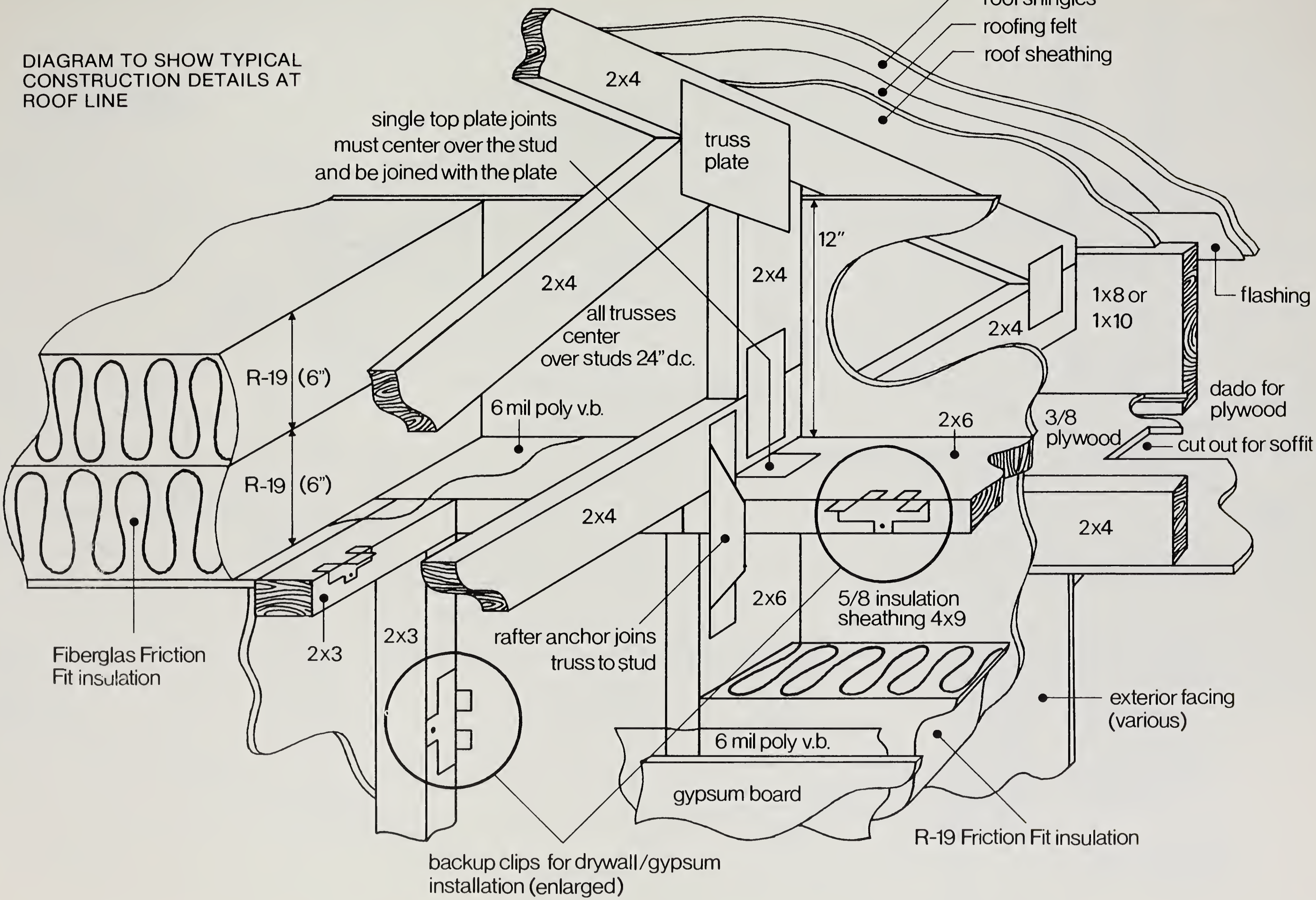
SECTION THRU SLAB

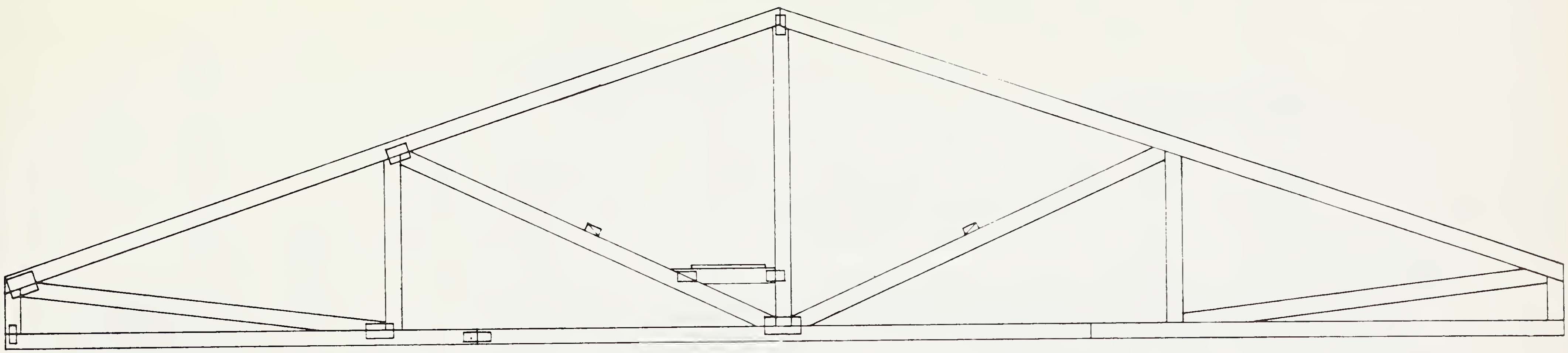


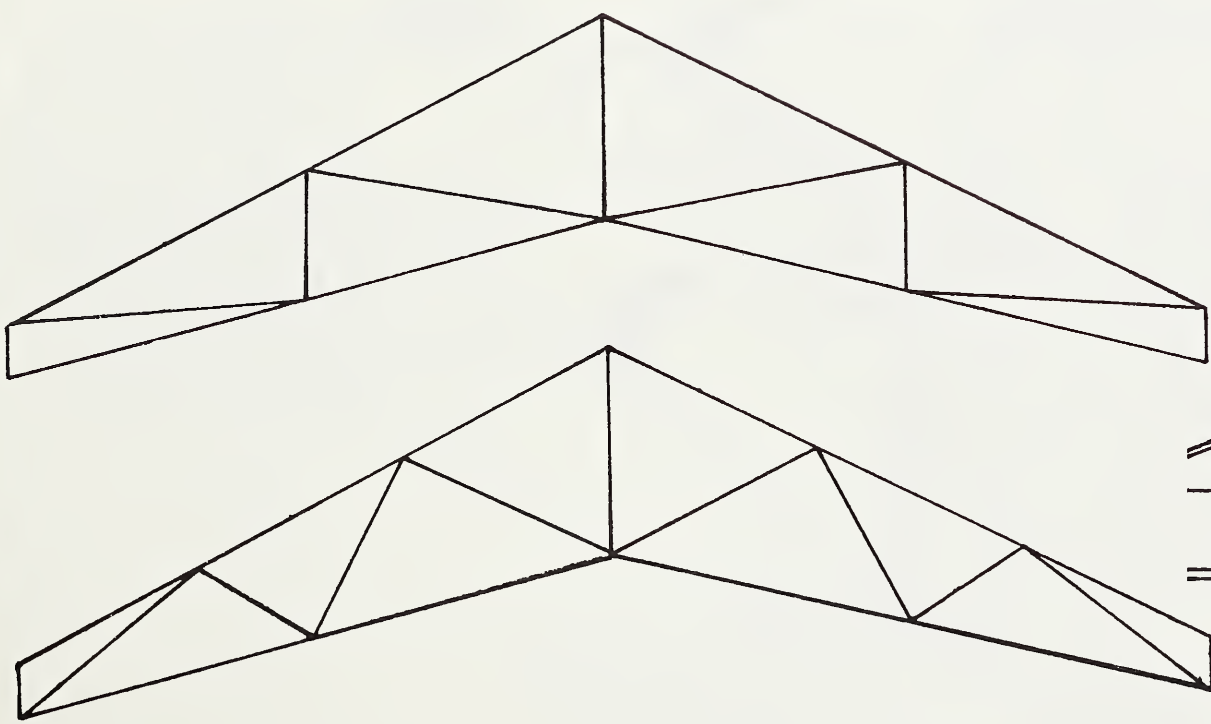
WALL SECTION - MONOLITHIC SLAB ENERGY CONSERVATION

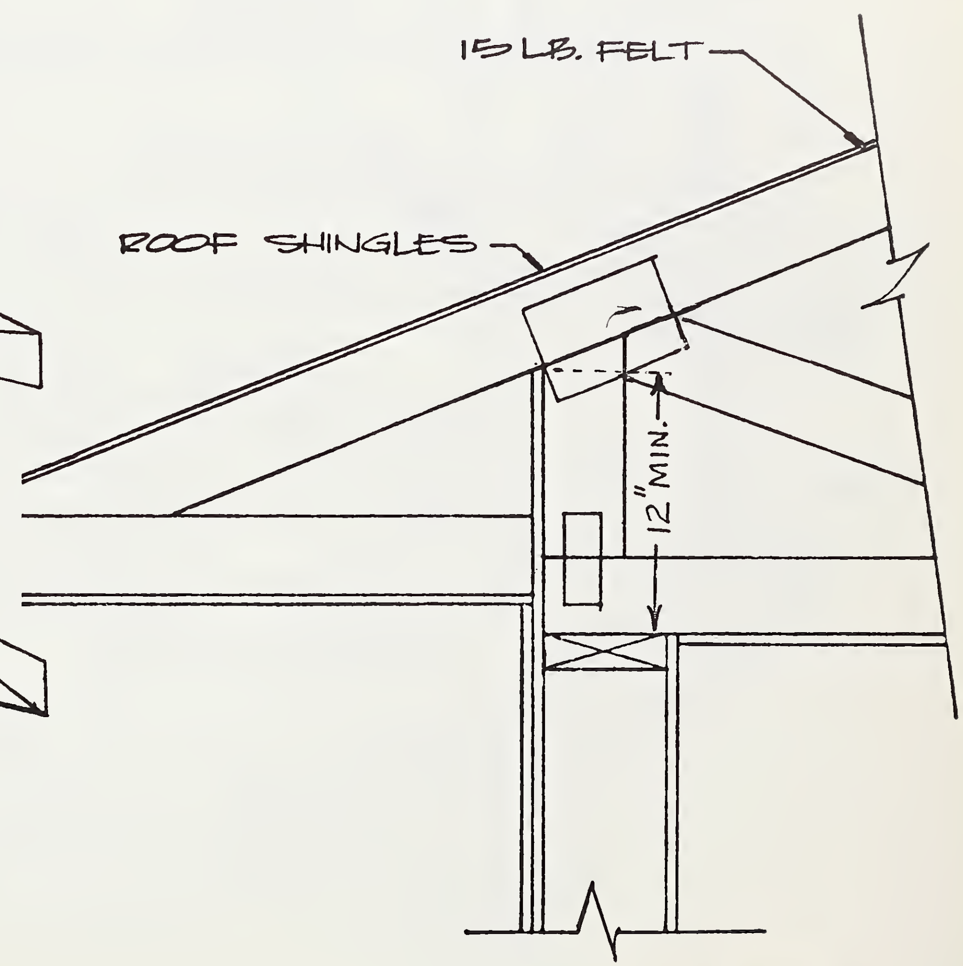
4-10-75
F. N. S.

DIAGRAM TO SHOW TYPICAL CONSTRUCTION DETAILS AT ROOF LINE







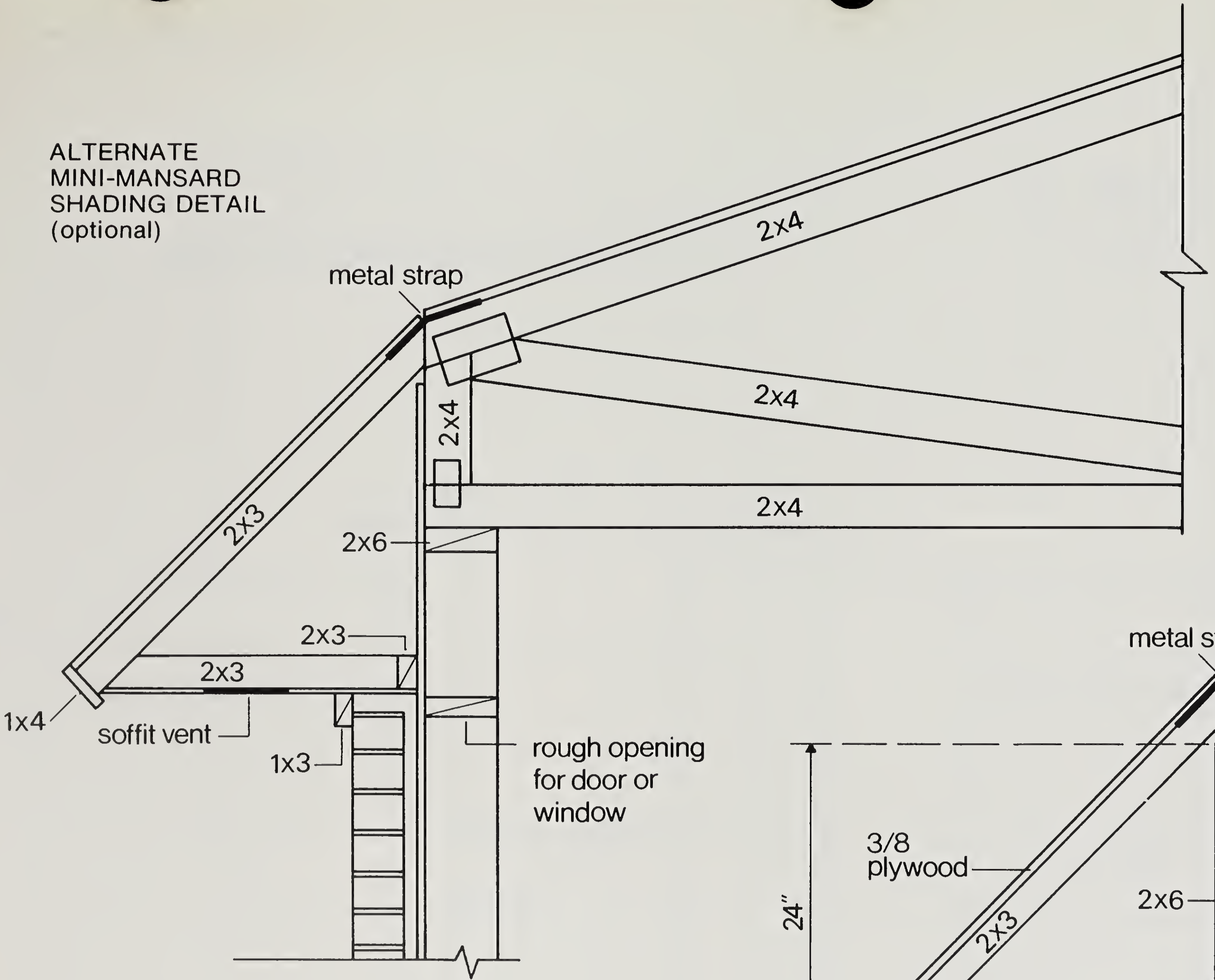


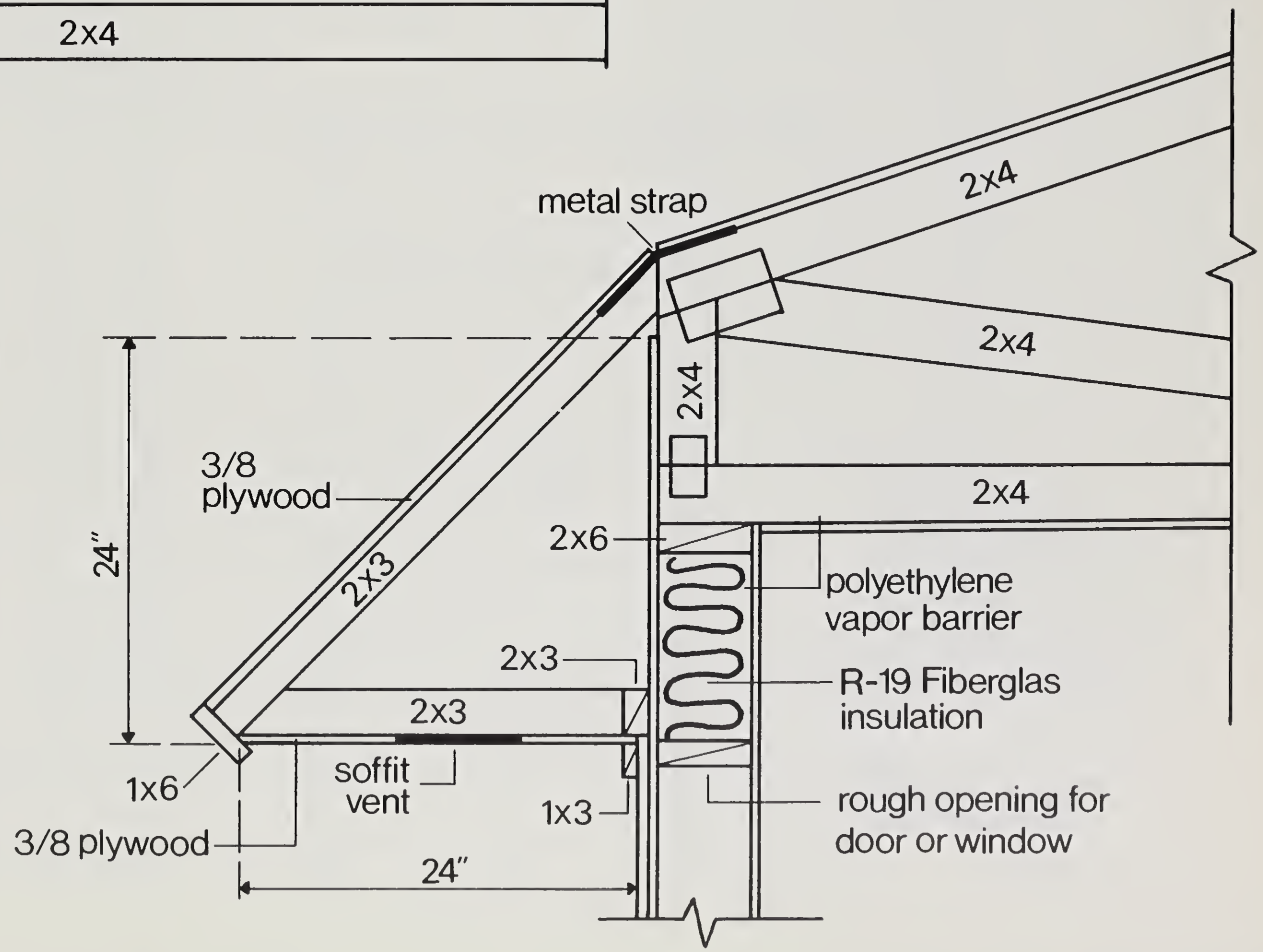
Truss Configurations (Typical)

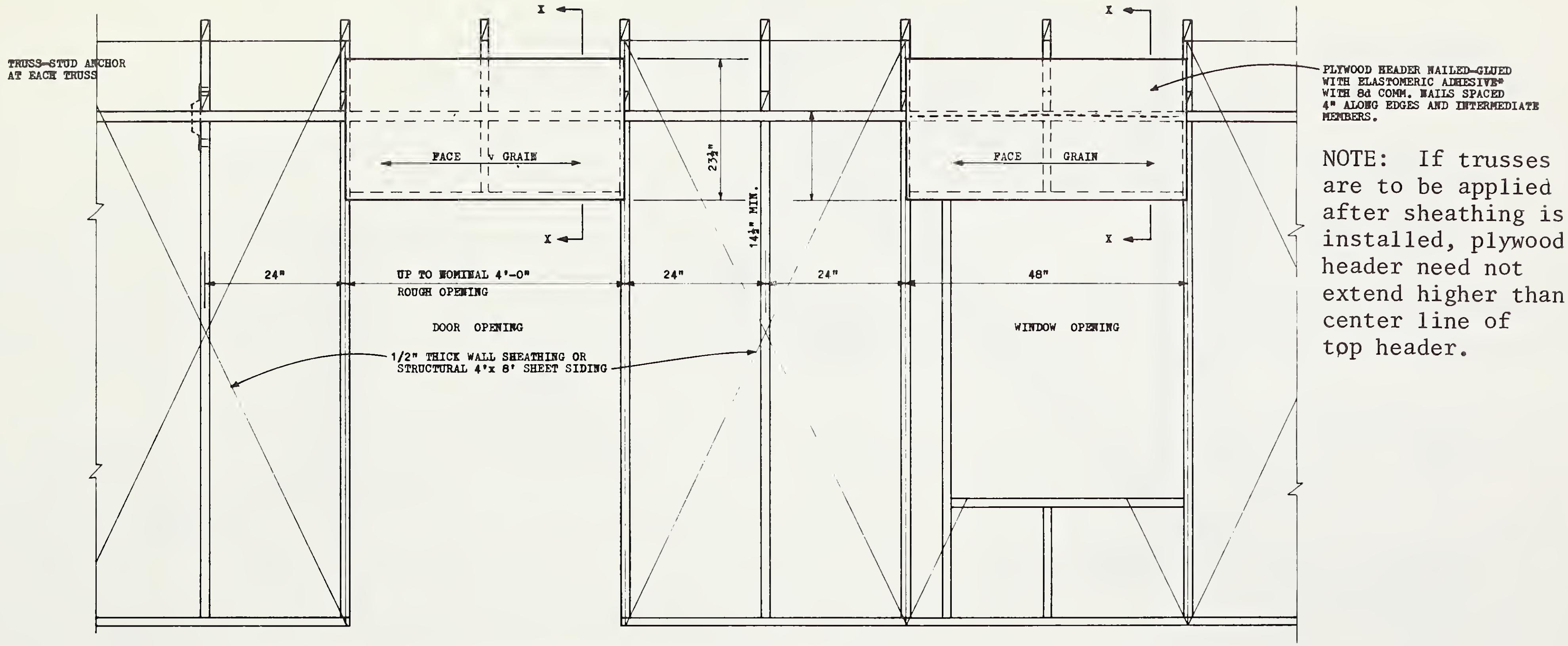
1. Cut all members to bear
2. Center all plates on joints unless otherwise noted
3. Lateral bracing required at midpoint
4. Top cord may be extended according to owner's desire

Cathedral truss configurations courtesy Hydro-Aire Engineering, Inc.
For size of framing members and full data consult your local
Hydro-Aire truss fabricator listed in the Yellow Pages.

ALTERNATE
MINI-MANSARD
SHADING DETAIL
(optional)

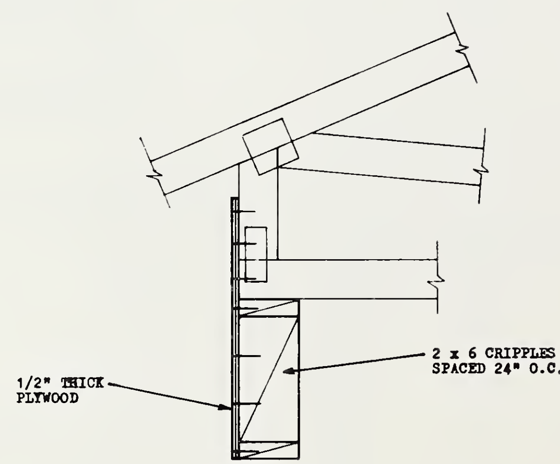






ELEVATION OF EXTERIOR LOAD BEARING WALL WITH PLYWOOD NAILED-GLUED HEADERS FOR SPANS UP TO NOMINAL 4-FEET, FOR HOUSES HAVING A MAXIMUM DEPTH OF 36-FEET.

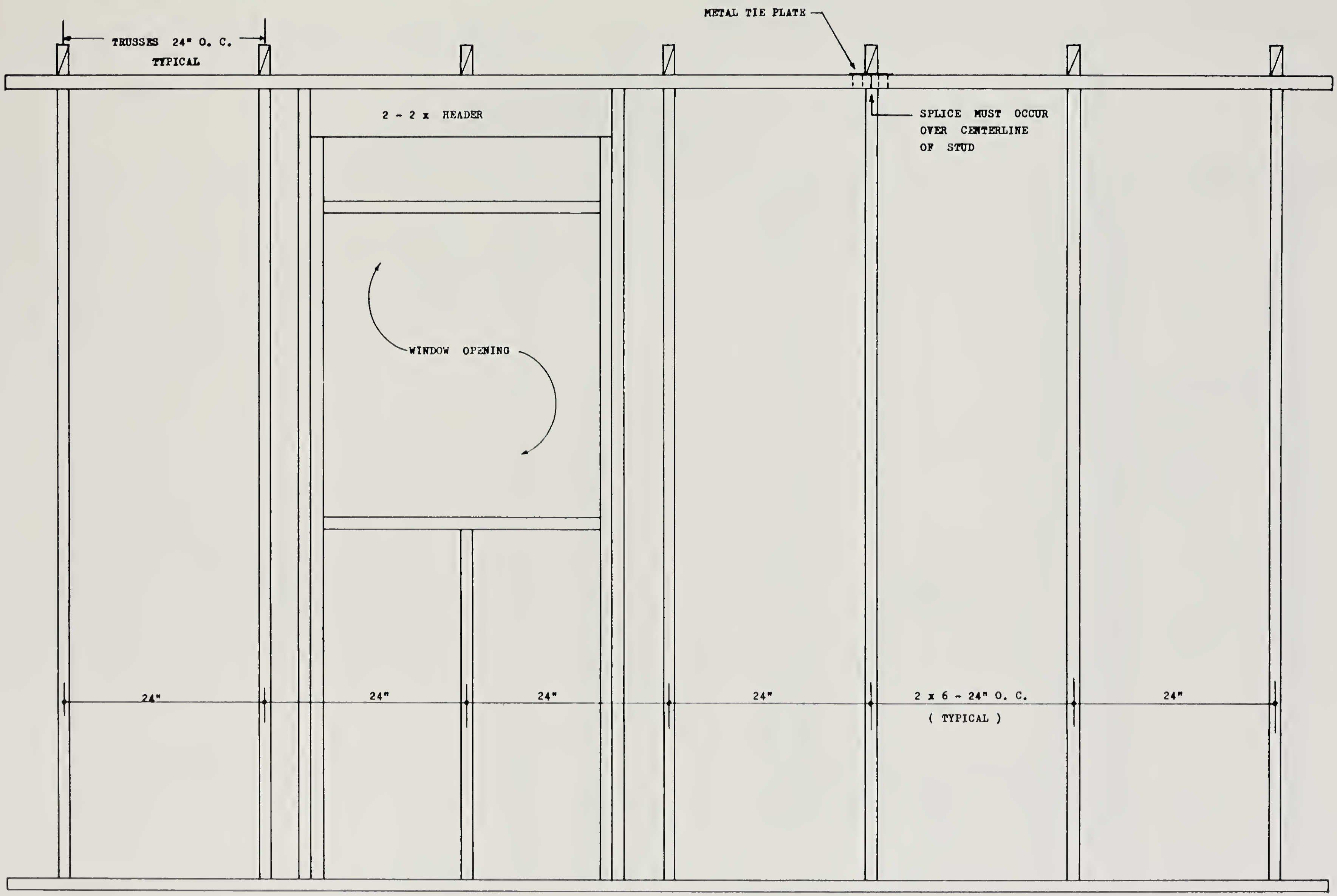
SCALE: ONE FOOT



SECTION X - X

PLYWOOD SHALL BE NOT LESS THAN 1/2" THICK STANDARD GRADE PLYWOOD WITH EXTERIOR GLUE CONFORMING TO U.S. DEPT. OF COMMERCE PRODUCT STANDARD P.S. 1-66.

* ANY ADHESIVE MEETING THE REQUIREMENTS OF AMERICAN PLYWOOD ASSOCIATION SPECIFICATION AFG - 01

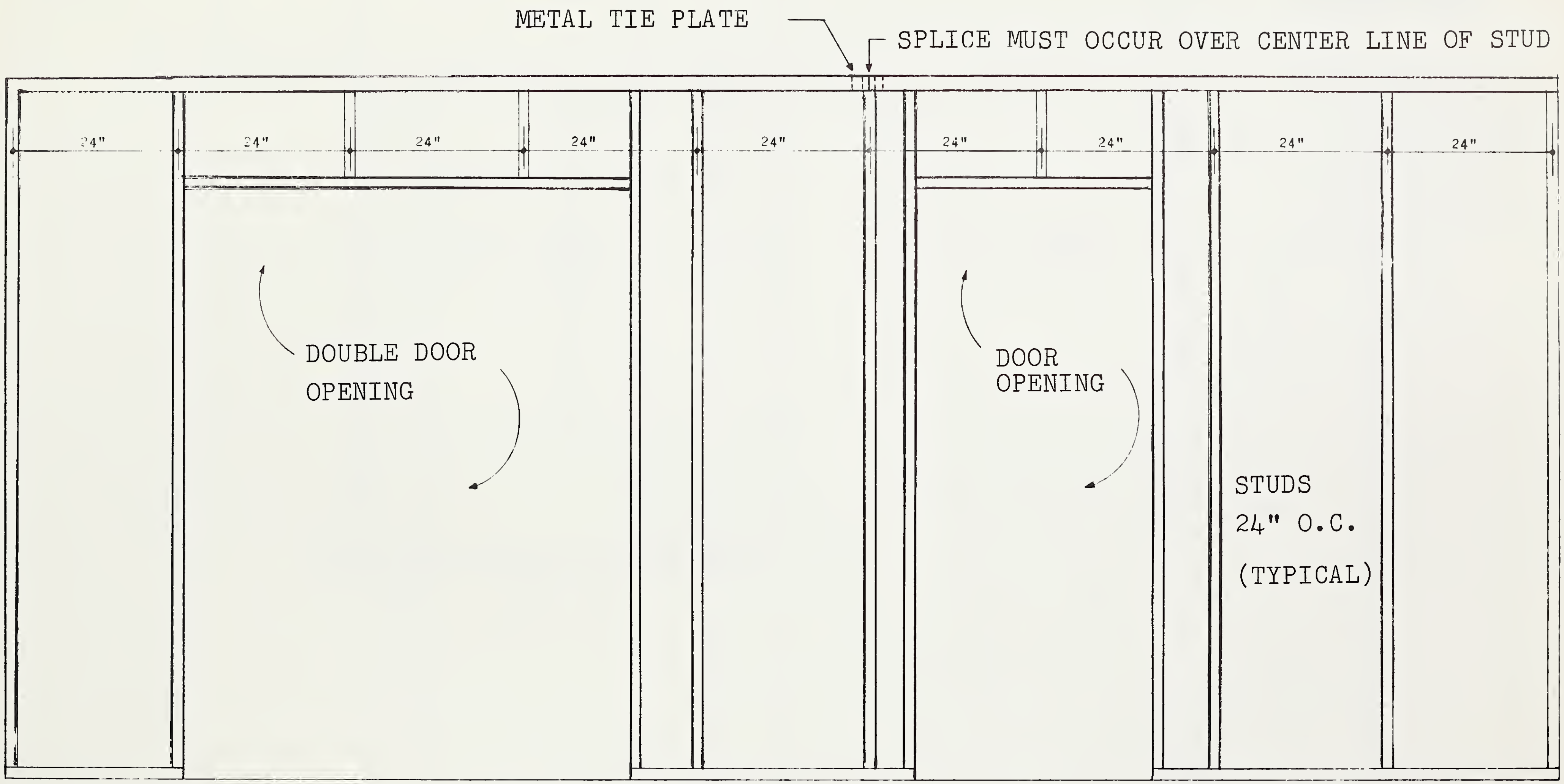


ELEVATION OF LOAD BEARING EXTERIOR WALL

SCALE: ONE FOOT

FMH 7-74

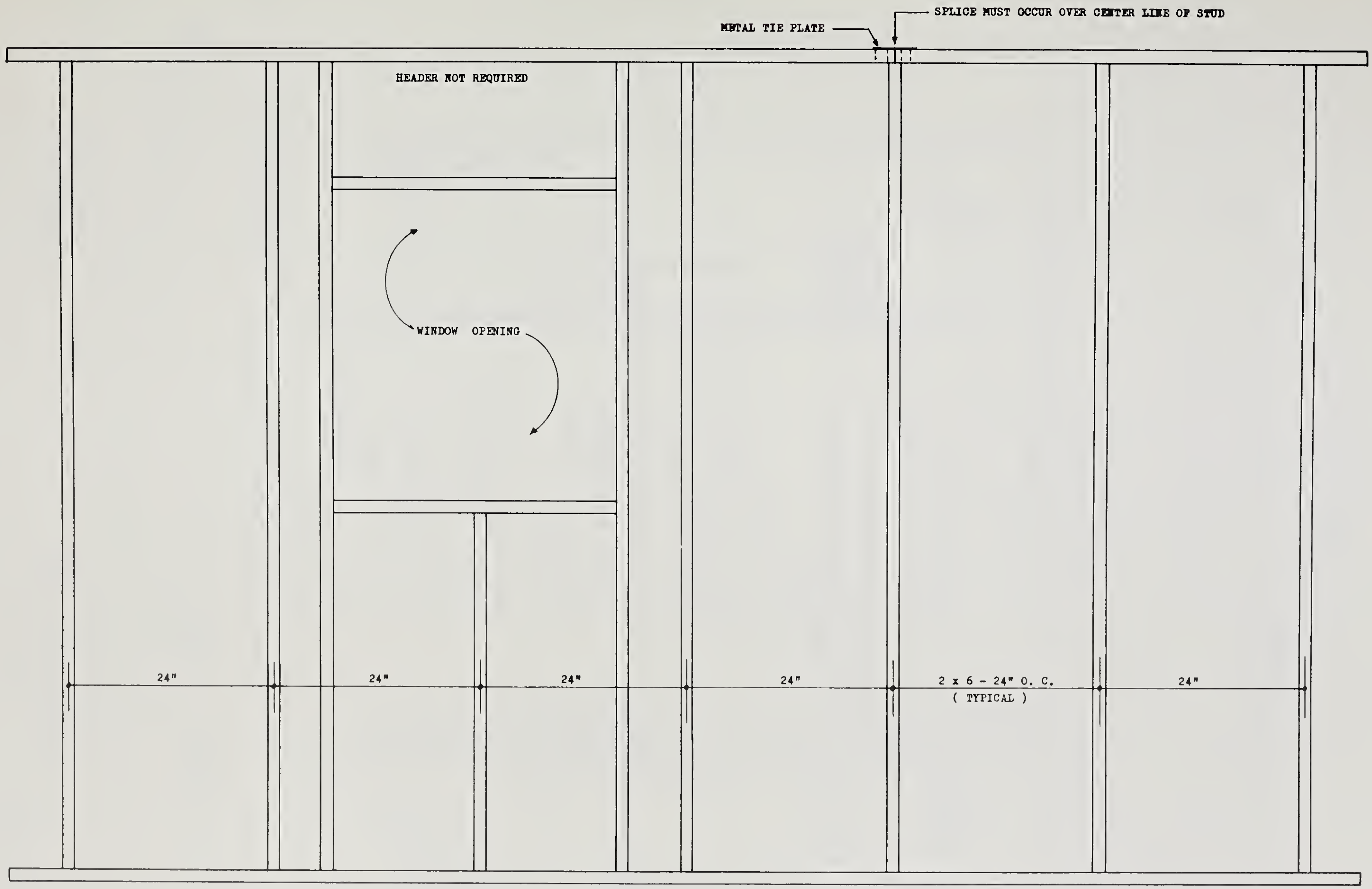
LR. PLATE NO. 4



ELEVATION OF INTERIOR WALL

SCALE: ONE FOOT

LR. PLATE NO. 3



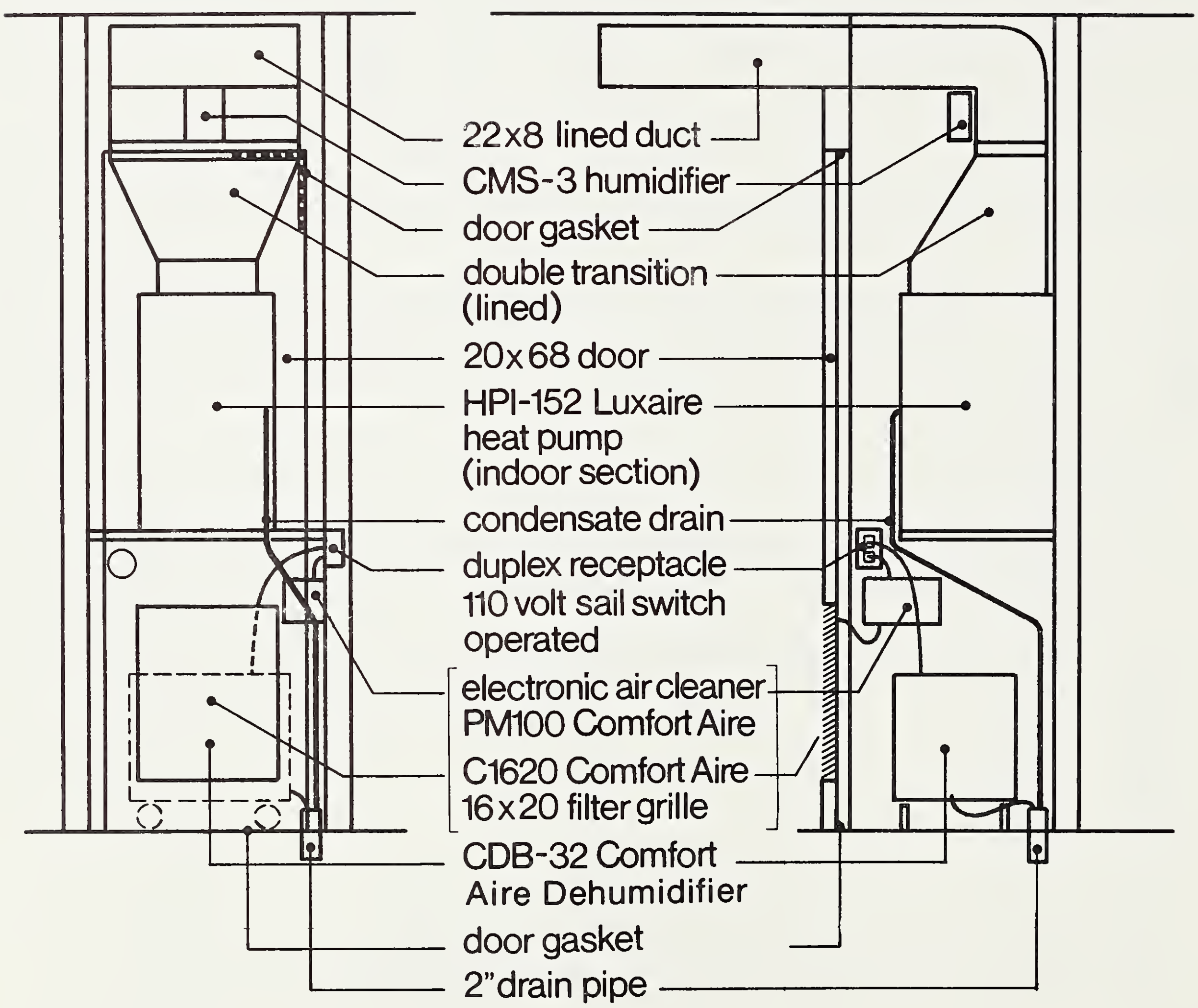
ELEVATION OF NON - LOAD BEARING EXTERIOR WALL

SCALE· ONE FOOT

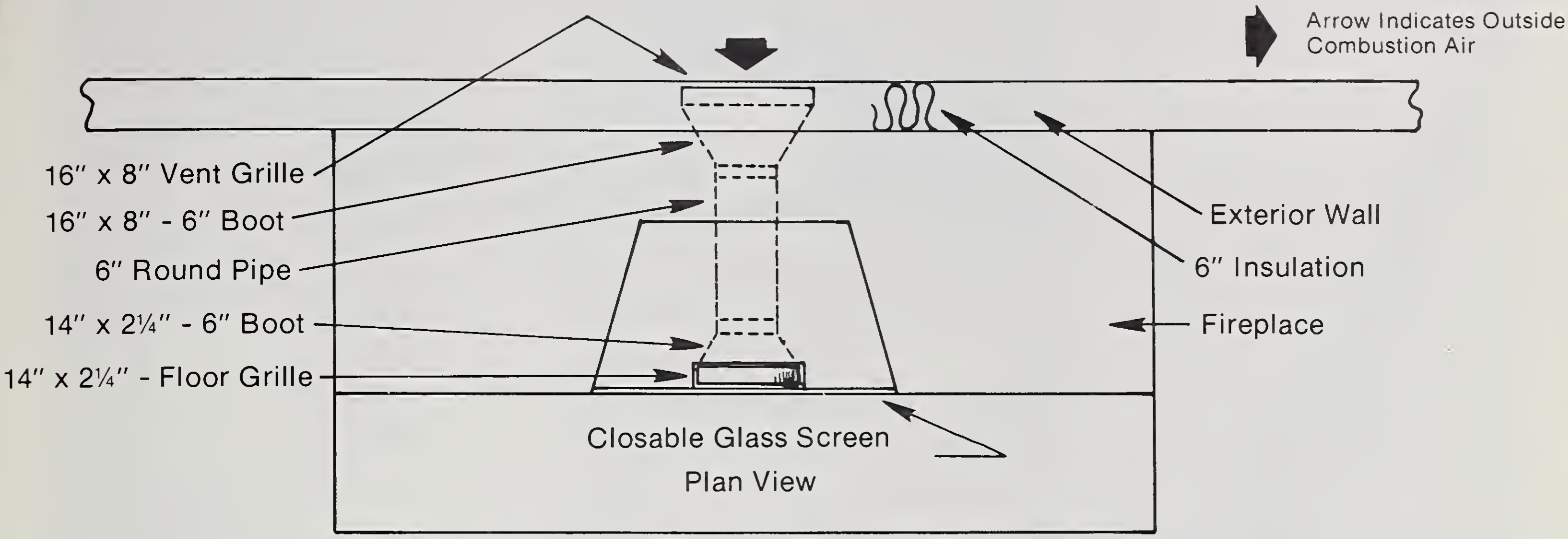
FMH 7-74

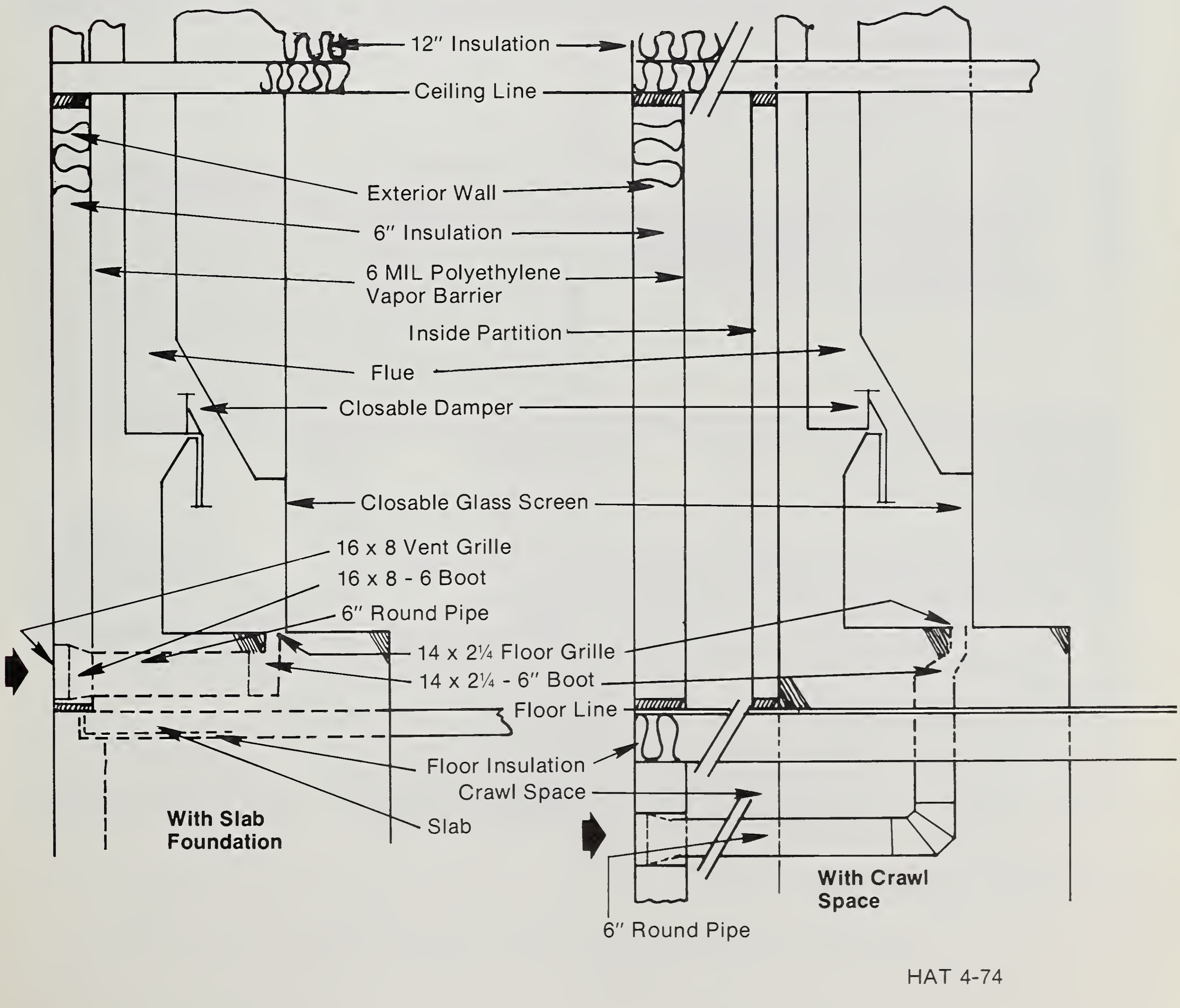
LR. PLATE NO. 2

EQUIPMENT CLOSET

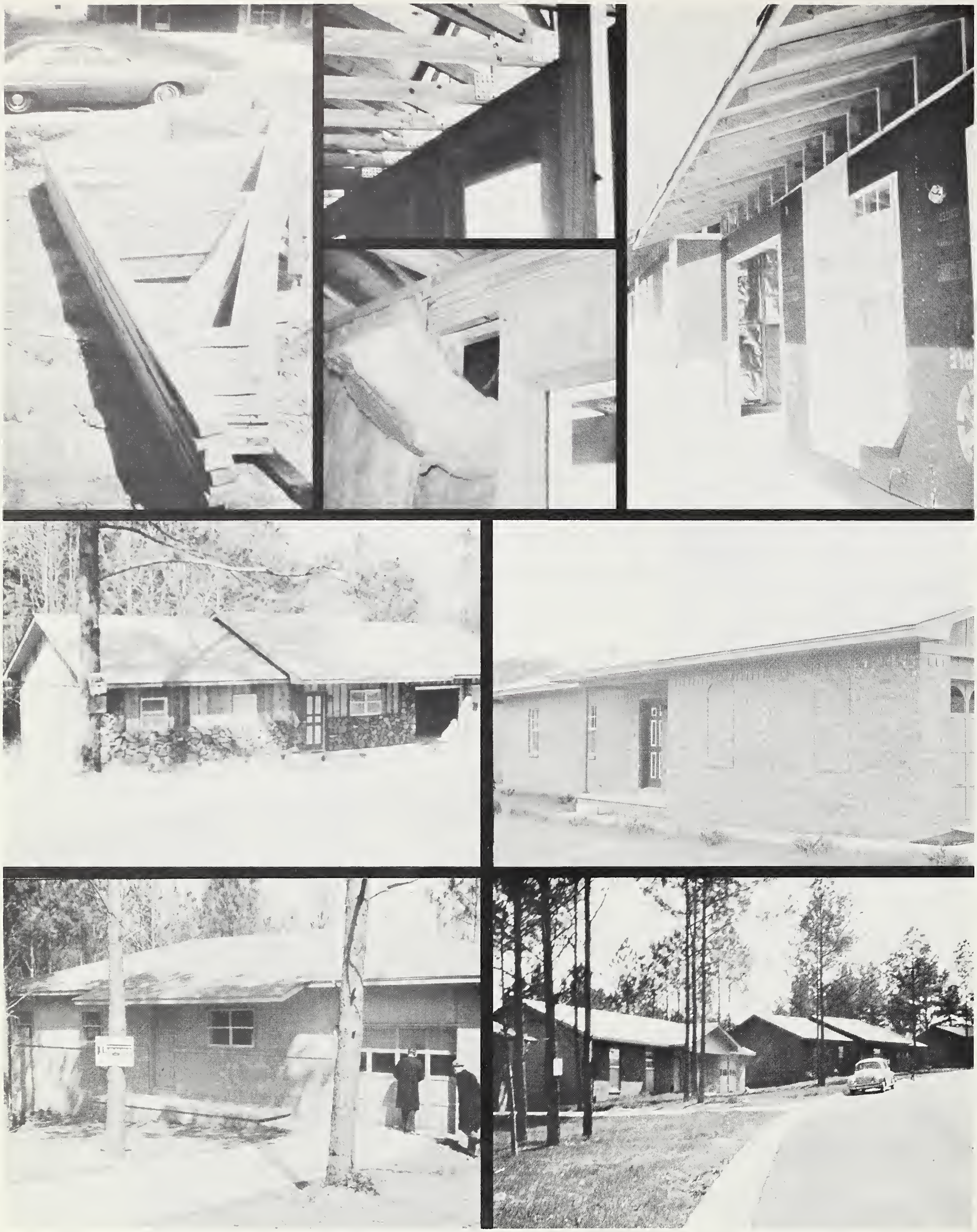


Fireplace Installation For Super Thermal Homes





HAT 4-74



ENERGY CONSERVATION HOMES AND CONSTRUCTION DETAILS

Form 130 Rev. 1-74

ARKANSAS MIDDLE SOUTH UTILITIES SYSTEM

ARKANSAS POWER & LIGHT
HELPING BUILD ARKANSAS

Plan 274
1200 Square Feet
Energy Conservation
Construction

RESIDENTIAL ELECTRIC COMFORT CONDITIONING

For__________ of __________
No. Street City

Built By__________ of __________
No. Street City

Comfort Conditioning
By__________ of __________
No. Street City

DESIGN CONDITIONS

Winter		Summer
5 °F	Outdoor Temperature	100 °F
75 °F	Indoor Temperature	75 °F
70 °F	Temperature Differential	25 °F
___ %	Indoor Relative Humidity	___ %

STRUCTURAL CHARACTERISTICS

Gross Exposed Wall Area	1120 sq. ft.	Glass Area	5.333 % Floor Area
Ceiling Area Outside Dim.	1200 sq. ft.	Total Heat Loss	15806 BTUH
Floor Area Inside Dim.	___ sq. ft.	Unit Heat Loss	13.17 BTUH/Sq. Ft.
Total Glass Area	64 sq. ft.	Total Heat Gain	12179 BTUH

Structure Faces ______

EQUIPMENT TO BE INSTALLED

Heat Pump & Supplementary: Compressor 17500 BTUH, ____ CFM, And Supplementary ____ BTUH
Manufacturer & Model No. __________

Resistance Heating: Type __________; Capacity ____ BTUH And ____ CFM
Manufacturer & Model No. __________

Cooling Equipment: Capacity ____ BTUH And ____ CFM
Manufacturer & Model No. __________

Filter Equipment: Type Electrostatic
Manufacturer & Model No. __________

Humidifier: Type __________ Rating ____ Gal./Day
Manufacturer & Model No. __________

Dehumidifier: Type Mechanical Rating ____ Gal./Day
Manufacturer & Model No. __________

Attic Ventilation: Rating 790 CFM; Control Thermostatic
Manufacturer & Model No. __________

ESTIMATED COST OF OPERATION

	DESIGN NO. 1	DESIGN NO. 2	DESIGN NO. 3
Heating Season of ___ Degree Hrs. ___ KWH @ ___ ¢ =	$____ Yr.	$____ Yr.	$____ Yr.
Cooling Season of ___ Degree Hrs. ___ KWH @ ___ ¢ =	$____ Yr.	$____ Yr.	$____ Yr.
Heating & Cooling	$____ Yr.	$____ Yr.	$____ Yr.
Estimated Cost of Total Electrical Usage of This Home Appliances, Lighting, Heating & Cooling With Levelized Billing	$____ Mo.	$____ Mo.	$____ Mo.

Calculation of BTUH heat gain and loss are based on thermal control as follows: Insulation of R___ ceiling, R___ walls, R___ floor; vapor barrier type ___ ceiling, ___ walls, ___ floor; ground cover type ___; kitchen exhaust ___ manual, ___ auto.; other __________

Any change in thermal protection will affect the equipment size and estimated operating cost.

Date__________ Signature__________

TABLE 1. LOAD CALCULATIONS

			BR 1	Bath 2	Bath 1	Kitch	Dining	BR 3	BR 2	LR
1	Name of Room or Space		BR 1	Bath 2	Bath 1	Kitch	Dining	BR 3	BR 2	LR
2	Ceiling Height		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
3	Linear-Ft. of Exposed Wall	(a)	27.5	8.5	0	8.5	30.0	24.5	13.0	28.0
		(b)								
4	Gross Exposed Wall Area	(a)	220	68	0	68	240	196	10[illegible]	22[illegible]
		(b)								
5	Window and Door Area	(a) windows	10	0	0	6	15	9	9	15
		(b) doors	-	-	-	-	18	-	-	20
6	Net Exposed Wall Area	(a)	210	68	0	62	207	187	95	189
		(b)								
7	Window & Door Crackage — Linear Feet		16	0	0	12	19/19	15	15	19/20
8	Ceiling Area (Outside Dimensions)		192	52	69	114	217	156	172	228
9	Floor (Outside Dimensions)	(a) Sq-Ft Area								
		(b) Ln-Ft Perimeter (Slab)	27.5	8.5	0	8.5	30.0	24.5	13.0	28.0
	HEAT LOSS									
10	Of Windows And Doors	Sq-Ft (Line 5a) × 42.7 HTF	427	0	0	256	641	384	384	641
		Sq-Ft (Line 5b) × 7.4 HTF	-	-	-	-	133	-	-	148
11	Of Net Exposed Wall	Sq-Ft (Line 6a) × 3.6 HTF	756	245	0	223	745	673	342	681
		Sq-Ft (Line 6b) × HTF								
12	By Infiltration	Ln-Ft (Line 7) × W-22 D-34 HTF	354	0	0	265	420/646	332	332	420/680
13	At Ceiling	Sq-Ft (Line 8) × 1.7 HTF	326	89	117	194	369	265	292	388
14	At Floor	Sq-Ft (Line 9a) × HTF								
		Ln-Ft (Line 9b) × 22.7 HTF	624	193	0	193	681	556	295	636
15	Of Structure	Lines 10 + 11 + 12 + 13 + 14	2487	527	117	1131	3635	2210	1645	3594
16	Equipment Requirements	WATTS								
		BTUH *	2562	543	121	1165	3744	2276	1694	370[illegible]
		CFM (Actual)†	97	21	5	45	142	86	64	14[illegible]
	HEAT GAIN									
17	Of Windows And Doors	Sq-Ft (Line 5a) × 15.3 HTF	153	0	0	92	230	138	138	230
		Sq-Ft (Line 5b) × 2.7 HTF					49			54
18	Of Net Exposed Wall	Sq-Ft (Line 6a) × 1.3 HTF	273	88	0	81	269	243	124	246
		Sq-Ft (Line 6b) × HTF								
19	By Infiltration	Ln-Ft (Line 7) × W 7.9 D 12.2 HTF	126	0	0	95	150/232	119	119	150/244
20	At Ceiling	Sq-Ft (Line 8) × 0.7 HTF	134	36	48	80	153	109	120	160
21	At Floor	Sq-Ft (Line 9a) × HTF								
		Ln-Ft (Line 9b) × 0 HTF								
22	Sensible	Lines 17 + 18 + 19 + 20 + 21	686	124	4[illegible]	348	1083	609	501	1084
23	Equipment Requirements	BTUH *	1864	337	130	946	2942	1655	1360	2945
		CFM (Adjusted)	92	17	5	47	145	8[illegible]	67	145

* Actual BTU including duct loss for each room

† Based on 400 CFM per ton

TOTAL HEAT GAIN AND LOSS

Gains—Size Equipment On Cooling Load	with shading DESIGN NO. 1	no shading DESIGN NO. 2	DESIGN NO. 3
Sensible Gain (Line 22, Table 1)	4483	4483	
Latent Gain, 30% Sensible Gain	1345	1345	
Solar Gain, (Table 3) 83.5 × 33 sq. ft. [1]x29.2= [2]x83.5=	964	2756	
People 6 (Min-5) × 300 × 1.80	3240	3240	
Subtotal	10032	11824	
Duct Gain 3 % of Subtotal	301	355	
Total BTUH Heat Gain	10333	12179	

[1]Design 1. [2]Design 2.

Losses—Design Room CFM On Heating Lo[illegible]

Structural Loss (Line 15, Table 1)

Duct Loss 3 % of Structural Loss

Total BTUH Heat Loss

Based On 400 CFM/Ton

				Design No. 1	Design No. 2	Design No. 3
				Total		
				140		
				1120		
				64		
				38		
				1018		
				96/39		
				1200		
				140		

				2733		
				281		
				3665		
				2123/1326		
				2040		
				3178		
				15346		
				15806		
				600		

				981		
				103		
				1324		
				759/476		
				840		
				4483		
					12179	
					600	

ld

	DESIGN NO. 1	DESIGN NO. 2	DESIGN NO. 3
	15346		
	460		
	15806		

CFM Required

Notes:

TABLE 2. WINDOW & DOOR SCHEDULE

Symbol	Dimensions	No.	Type	Sq. Ft. Area Ea. / Total	Ln. Ft. Crackage Ea. / Total
A	3-0 x 5-0	2	storm	15 / 30	19 / 38
B	3-4 x 3-0	1	storm	10 / 10	16 / 16
C	3-0 x 3-0	2	storm	9 / 18	15 / 30
D	2-0 x 3-0	1	storm	6 / 6	12 / 12
				/ 64	/ 96
				/	/
1	3-0 x 6-8	1	ins dr	20 / 20	20 / 20
2	2-8 x 6-8	1	ins dr	18 / 18	19 / 19
				/ 38	/ 39
				/	/
				/	/
				/	/
				/ 102	/ 135

TABLE 3. SOLAR AREAS OF WEST AND SOUTH ELEVATIONS

Symbol	West No.	West Total Area	South No.	South Total Area
A	1	15		0
C	2	18		0
Totals		33		0

Use The Larger Of These Two Total Areas To Calculate Solar Gain

Energy Conservation Construction

Ceiling R-38
Walls R-19
Floor R-10.7 (slab perimeter)

Storm windows
Insulated Metal Doors

Indicate North

OUTLINE PLAN OF STRUCTURE

DESIGN TEMPERATURE DIFFERENTIAL (TD)	HEAT TRANSFER FACTORS (HTF) HEAT LOSS 75°	70°	65°	60°	HEAT GAIN 30°	25°	20°
WINDOWS (Weather stripped)							
Single Pane	84.8	79.1	73.5	67.8	31.8	26.5	21.2
Single Pane and Storm Windows	45.8	42.7	39.7	36.6	18.3	15.3	12.2
Insulating Glass	47.5	44.3	41.2	38.0	19.0	15.8	12.7
Triple Glazed	31.5	29.4	27.3	25.2	12.6	10.5	8.4
DOORS (Weather stripped)							
Hollow Core	84.8	79.1	73.5	67.8	31.8	26.5	21.2
Hollow Core and Storm Door	47.5	44.3	41.2	38.0	19.0	15.8	12.7
Solid Core (1¾")	36.0	33.6	31.2	28.8	14.4	12.0	9.6
Solid Core (1¾") and Storm Door	23.3	21.7	20.2	18.6	9.3	7.8	6.2
Metal Insulated door		7.4				2.7	
INFILTRATION (Doors and Windows)							
Without Storm Sash or Door	36.5	34.0	31.6	29.2	14.6	12.2	9.7
With Storm Sash or Door	23.7	22.1	20.5	19.0	9.5	7.9	6.3
Metal Insulated door		34.0				12.2	
WALLS							
Frame Standard Sheathed No Insulation	18.2	16.9	15.7	14.5	7.3	6.1	4.9
Brick Standard Sheathed No Insulation	20.0	18.6	17.3	16.0	8.0	6.7	5.3
Brick or Frame Standard Sheathed: 2" Insulation (R-7.0)	8.6	8.1	7.5	6.9	3.5	2.9	2.4
3½" Insulation (R-11)	6.1	5.8	5.3	4.9	2.5	2.1	1.7
6" Insulation (R-19)	3.9	3.6	3.4	3.1	1.6	1.3	1.1
2" Insulation (R-7.0) Cavity, Impregnated Vermiculite Poured	7.5	7.0	6.5	6.0	3.0	2.5	2.0
3½" Insulation (R-11) Cavity, Impregnated Vermiculite Poured	5.5	5.2	4.8	4.4	2.2	1.9	1.5
6" Insulation (R-19) Cavity, Impregnated Vermiculite Poured	3.7	3.4	3.2	2.9	1.5	1.2	1.0
8" Solid Wall Brick or Stone: No Insulation	50.3	46.9	43.6	40.3	20.1	16.8	13.4
Gypsum Wallboard, Furred With 2" Insl. (R-7.0)	8.5	7.9	7.4	6.8	3.4	2.8	2.3
4" Brick & 8" Concrete Block: No Insulation	32.3	30.1	28.0	25.8	13.0	10.8	8.9
Blocks, Impregnated Vermiculite Poured	23.3	21.7	20.2	18.6	9.3	7.8	6.2
Standard Aggregate Concrete Block: 6" Block No Insulation	42.6	39.8	36.9	34.1	17.1	14.2	11.4
8" Block No Insulation	38.3	35.7	33.2	30.6	15.3	12.8	10.2
12" Block No Insulation	35.2	32.9	30.5	28.2	14.1	11.7	9.4
6" Block Impregnated Vermiculite Poured	27.0	25.2	23.4	21.6	10.8	9.0	7.2
8" Block Impregnated Vermiculite Poured	25.5	23.8	22.1	20.4	10.2	8.5	6.8
12" Block Impregnated Vermiculite Poured	24.8	23.1	21.1	19.8	9.9	8.3	6.6
Light Weight Aggregate Concrete Block: 6" Block No Insulation	28.3	26.4	24.5	22.6	11.3	9.4	7.5
8" Block No Insulation	25.8	24.1	22.4	20.7	10.3	8.6	6.9
12" Block No Insulation	22.9	21.4	19.9	18.3	9.2	7.7	6.1
6" Block Impregnated Vermiculite Poured	17.6	16.4	15.2	14.0	7.0	5.9	4.7
8" Block Impregnated Vermiculite Poured	16.6	15.5	14.4	13.6	6.6	5.6	4.5
12" Block Impregnated Vermiculite Poured	16.1	15.0	13.7	12.9	6.4	5.4	4.3
CEILING							
Pitched Roof: 6" Insulation (R-19.0) Standard Ventilation	3.9	3.6	3.4	3.1	2.1	1.8	1.6
8" Insulation (R-25.3) Standard Ventilation	3.0	2.8	2.6	2.4	1.6	1.4	1.2
10" Insulation (R-31.7) Standard Ventilation	2.4	2.3	2.1	1.9	1.3	1.1	1.0
12" Insulation (R-38.0) Standard Ventilation	2.1	1.9	1.8	1.7	1.1	1.0	0.8
Hipped or Flat Roof: 6" Insulation (R-19.0) Standard Ventilation	3.4	3.2	2.9	2.7	3.1	2.6	2.1
8" Insulation (R-25.3) Standard Ventilation	2.7	2.5	2.3	2.1	2.4	2.0	1.6
10" Insulation (R-31.7) Standard Ventilation	2.3	2.1	1.9	1.7	1.9	1.6	1.3
12" Insulation (R-38.0) Standard Ventilation	1.8	1.7	1.6	1.5	1.7	1.4	1.1
Pitched, Hipped or Flat Roof: 6" Insulation (R-19.0) Controlled Ventilation	3.4	3.2	2.9	2.7	1.5	1.3	1.0
8" Insulation (R-25.3) Controlled Ventilation	2.7	2.5	2.3	2.1	1.4	1.2	0.9
10" Insulation (R-31.7) Controlled Ventilation	2.3	2.1	1.9	1.7	1.0	0.8	0.6
12" Insulation (R-38.0) Controlled Ventilation	1.8	1.7	1.6	1.5	0.8	0.7	0.5
FLOOR							
Double Wood and Crawl Space: 2" Insulation (R-7)	4.8	4.5	4.2	3.9	1.5	1.2	1.0
3½" Insulation (R-11)	3.3	3.1	2.9	2.6	1.3	1.1	0.9
6" Insulation (R-19)	2.0	1.8	1.6	1.5	0.8	0.6	0.5
1½" Urethane		22.7				.0	
Slab on Ground: 1" Insulation (R-3.5) Standard Duct System	66.8	62.3	57.9	53.4	.0	.0	.0
2" Insulation (R-7) Standard Duct System	35.8	33.4	32.6	31.8	.0	.0	.0
1" Insulation (R-3.5) Perimeter Duct	199.3	186.9	173.7	160.2	.0	.0	.0
2" Insulation (R-7) Perimeter Duct	107.4	100.2	97.8	95.4	.0	.0	.0

Note: (A) For additional factors, use the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Guide & Data Book.

(B) All above factors include correctly applied vapor barriers.

(C) Above factors are based on blanket insulation; adjust for blown material.

Form 130 Rev. 1-74

ARKANSAS POWER & LIGHT
MIDDLE SOUTH UTILITIES SYSTEM
HELPING BUILD ARKANSAS

Plan 274
1200 sq. ft.
Minimum Property
Standards

RESIDENTIAL ELECTRIC COMFORT CONDITIONING

For________ of ________ No. ____ Street ____ City

Built By________ of ________ No. ____ Street ____ City

Comfort Conditioning By________ of ________ No. ____ Street ____ City

DESIGN CONDITIONS

Winter		Summer
5 °F	Outdoor Temperature	100 °F
75 °F	Indoor Temperature	75 °F
70 °F	Temperature Differential	25 °F
____ %	Indoor Relative Humidity	____ %

STRUCTURAL CHARACTERISTICS

Gross Exposed Wall Area	1120 sq. ft.	Glass Area	10.67 % Floor Area
Ceiling Area Outside Dim.	1200 sq. ft.	Total Heat Loss	46,600 BTUH
Floor Area Inside Dim.	____ sq. ft.	Unit Heat Loss	38.8 BTUH/Sq. Ft.
Total Glass Area	128 sq. ft.	Total Heat Gain	27,078 BTUH

Structure Faces ______

EQUIPMENT TO BE INSTALLED

Heat Pump & Supplementary: Compressor______BTUH,______CFM, And Supplementary______BTUH
Manufacturer & Model No.______

Resistance Heating: Type______; Capacity ______BTUH And ______CFM
Manufacturer & Model No.______

Cooling Equipment: Capacity ______BTUH And ______CFM
Manufacturer & Model No.______

Filter Equipment: Type______
Manufacturer & Model No.______

Humidifier: Type______ Rating ______Gal./Day
Manufacturer & Model No.______

Dehumidifier: Type______ Rating ______Gal./Day
Manufacturer & Model No.______

Attic Ventilation: Rating ______CFM; Control______
Manufacturer & Model No.______

ESTIMATED COST OF OPERATION

	DESIGN NO. 1	DESIGN NO. 2	DESIGN NO. 3
Heating Season of ____ Degree Hrs. ____ KWH @____¢ =	\$______Yr.	\$______Yr.	\$______Yr.
Cooling Season of ____ Degree Hrs. ____ KWH @____¢ =	\$______Yr.	\$______Yr.	\$______Yr.
Heating & Cooling	\$______Yr.	\$______Yr.	\$______Yr.
Estimated Cost of Total Electrical Usage of This Home Appliances, Lighting, Heating & Cooling With Levelized Billing	\$______Mo.	\$______Mo.	\$______Mo.

Calculation of BTUH heat gain and loss are based on thermal control as follows: Insulation of R____ ceiling, R____ walls, R____ floor; vapor barrier type ____ ceiling, ____ walls, ____ floor; ground cover type ____; kitchen exhaust ____ manual, ____ auto.; other ______

Any change in thermal protection will affect the equipment size and estimated operating cost.

Date______ Signature______

TABLE 1. LOAD CALCULATIONS

			BR 1	Bath 2	Bath 1	Kitch.	Din.	BR 3	BR 2	L-R
1	Name of Room or Space		BR 1	Bath 2	Bath 1	Kitch.	Din.	BR 3	BR 2	L-R
2	Ceiling Height		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
3	Linear-Ft. of Exposed Wall	(a)	27.5	8.5	0	8.5	30.0	24.5	13.0	28.0
		(b)								
4	Gross Exposed Wall Area	(a)	220	68	0	68	240	196	104	[illegible]
		(b)								
5	Window and Door Area	(a)	20	4	0	8	48	18	18	50
		(b)								
6	Net Exposed Wall Area	(a)	200	64	0	60	192	178	86	174
		(b)								
7	Window & Door Crackage — Linear Feet		32	10	0	14	57	30	30	58
8	Ceiling Area (Outside Dimensions)		192	52	69	114	217	156	172	228
9	Floor (Outside Dimensions)	(a) Sq-Ft Area								
		(b) Ln-Ft Perimeter (Slab)	27.5	8.5	0	8.5	30	24.5	13	28
	HEAT LOSS									
10	Of Windows And Doors	Sq-Ft (Line 5a) × 79.1 HTF	1582	316	0	633	3797	1424	1424	3955
		Sq-Ft (Line 5b) × HTF								
11	Of Net Exposed Wall	Sq-Ft (Line 6a) × 5.8 HTF	1276	394	0	398	1392	1137	603	1299
		Sq-Ft (Line 6b) × HTF								
12	By Infiltration	Ln-Ft (Line 7) × 34 HTF	1088	340	0	476	1938	1020	1020	1972
13	At Ceiling	Sq-Ft (Line 8) × 3.6 HTF	691	187	248	411	781	562	619	821
14	At Floor	Sq-Ft (Line 9a) × HTF								
		Ln-Ft (Line 9b) × 62.3 HTF	1713	530	0	530	1869	1526	810	1744
15	Of Structure	Lines 10 + 11 + 12 + 13 + 14	6350	1767	248	2444	9777	5669	4476	9791
16	Equipment Requirements	WATTS								
		BTUH *	7302	2032	286	2810	11,244	6519	5147	11[illegible]
		CFM (Actual)	157	44	6	60	241	140	110	242
	HEAT GAIN									
17	Of Windows And Doors	Sq-Ft (Line 5a) × 26.5 HTF	530	106	0	212	1272	477	477	1325
		Sq-Ft (Line 5b) × HTF								
18	Of Net Exposed Wall	Sq-Ft (Line 6a) × 2.1 HTF	420	134	0	126	403	374	181	365
		Sq-Ft (Line 6b) × HTF								
19	By Infiltration	Ln-Ft (Line 7) × 12.2 HTF	390	122	0	171	695	366	366	708
20	At Ceiling	Sq-Ft (Line 8) × 1.8 HTF	346	94	124	205	391	281	310	410
21	At Floor	Sq-Ft (Line 9a) × HTF								
		Ln-Ft (Line 9b) × HTF								
22	Sensible	Lines 17 + 18 + 19 + 20 + 21	1686	456	124	714	2761	1498	1334	2808
23	Equipment Requirements	BTUH *	4012	1085	295	1699	6569	3564	3174	6680
		CFM (Adjusted)	149	40	11	63	242	132	117	246

* Actual BTU including duct loss.

TOTAL HEAT GAIN AND LOSS

Gains—Size Equipment On Cooling Load

	DESIGN NO. 1	DESIGN NO. 2	DESIGN NO. 3
Sensible Gain (Line 22, Table 1)	11381		
Latent Gain, 30% Sensible Gain	3414		
Solar Gain, (Table 3) 83.5 × 66 sq. ft.	5511		
People 6 (Min-5) × 300 × 1.80	3240		
Subtotal	23546		
Duct Gain 15 % of Subtotal	3532		
Total BTUH Heat Gain	27078		

Losses—Design Room CFM On Heating Lo

Structural Loss (Line 15, Table 1)

Duct Loss 15 % of Structural Loss

Total BTUH Heat Loss

Based On 400 CFM/Ton

				Design No. 1	Design No. 2	Design No. 3
				140		
				1120		
				166		
				954		
				231		
				1200		
				140		

				13131		
				6495		
				7854		
				4320		
				8722		
				40522		
				46600		
				1000		

				4399		
				2003		
				2818		
				2161		
				11381		
				27078		
				1000		

DESIGN NO. 1	DESIGN NO. 2	DESIGN NO. 3
40522		
6078		
46600		

Notes:

TABLE 2. WINDOW & DOOR SCHEDULE

Symbol	Dimensions	No.	Type	Sq. Ft. Area Ea. / Total	Ln. Ft. Crackage Ea. / Total
A	3-0 x 5-0	4	S.H.	15 / 60	19 / 76
B	3-4 x 3-0	2	S.H.	10 / 20	16 / 32
C	3-0 x 3-0	4	S.H.	9 / 36	15 / 60
D	2-8 x 6-8	1	S.H.	8 / 8	14 / 14
E	2-0 x 2-0	1	S.H.	4 / 4	10 / 10
				/ 128	/ 192
1	3-0 x 6-8	1	H.C.	20 / 20	20 / 20
2	2-8 x 6-8	1	H.C.	18 / 18	19 / 19
				/ 38	/ 39
				/	/
				/	/
				/	/
				/	/

TABLE 3. SOLAR AREAS OF WEST AND SOUTH ELEVATIONS

Symbol	West No.	West Total Area	South No.	South Total Area
A	2	30		0
C	4	36		0
Totals		66		0

Use The Larger Of These Two Total Areas To Calculate Solar Gain

Minimum Property Standards

Ceiling R-19
Walls R-11
Floor R-3.5 (slab perimeter)
Single Pane Windows
Hollow core doors.

Indicate North

OUTLINE PLAN OF STRUCTURE

DESIGN TEMPERATURE DIFFERENTIAL (TD)	HEAT TRANSFER FACTORS (HTF) HEAT LOSS 75°	70°	65°	60°	HEAT GAIN 30°	25°	20°
WINDOWS (Weather stripped)							
Single Pane	84.8	79.1	73.5	67.8	31.8	26.5	21.2
Single Pane and Storm Windows	45.8	42.7	39.7	36.6	18.3	15.3	12.2
Insulating Glass	47.5	44.3	41.2	38.0	19.0	15.8	12.7
Triple Glazed	31.5	29.4	27.3	25.2	12.6	10.5	8.4
DOORS (Weather stripped)							
Hollow Core	84.8	79.1	73.5	67.8	31.8	26.5	21.2
Hollow Core and Storm Door	47.5	44.3	41.2	38.0	19.0	15.8	12.7
Solid Core (1¾")	36.0	33.6	31.2	28.8	14.4	12.0	9.6
Solid Core (1¾") and Storm Door	23.3	21.7	20.2	18.6	9.3	7.8	6.2
INFILTRATION (Doors and Windows)							
Without Storm Sash or Door	36.5	34.0	31.6	29.2	14.6	12.2	9.7
With Storm Sash or Door	23.7	22.1	20.5	19.0	9.5	7.9	6.3
WALLS							
Frame Standard Sheathed No Insulation	18.2	16.9	15.7	14.5	7.3	6.1	4.9
Brick Standard Sheathed No Insulation	20.0	18.6	17.3	16.0	8.0	6.7	5.3
Brick or Frame Standard Sheathed: 2" Insulation (R-7.0)	8.6	8.1	7.5	6.9	3.5	2.9	2.4
3½" Insulation (R-11)	6.1	5.8	5.3	4.9	2.5	2.1	1.7
6" Insulation (R-19)	3.9	3.6	3.4	3.1	1.6	1.3	1.1
2" Insulation (R-7.0) Cavity, Impregnated Vermiculite Poured	7.5	7.0	6.5	6.0	3.0	2.5	2.0
3½" Insulation (R-11) Cavity, Impregnated Vermiculite Poured	5.5	5.2	4.8	4.4	2.2	1.9	1.5
6" Insulation (R-19) Cavity, Impregnated Vermiculite Poured	3.7	3.4	3.2	2.9	1.5	1.2	1.0
8" Solid Wall Brick or Stone: No Insulation	50.3	46.9	43.6	40.3	20.1	16.8	13.4
Gypsum Wallboard, Furred With 2" Insl. (R-7.0)	8.5	7.9	7.4	6.8	3.4	2.8	2.3
4" Brick & 8" Concrete Block: No Insulation	32.3	30.1	28.0	25.8	13.0	10.8	8.9
Blocks, Impregnated Vermiculite Poured	23.3	21.7	20.2	18.6	9.3	7.8	6.2
Standard Aggregate Concrete Block: 6" Block No Insulation	42.6	39.8	36.9	34.1	17.1	14.2	11.4
8" Block No Insulation	38.3	35.7	33.2	30.6	15.3	12.8	10.2
12" Block No Insulation	35.2	32.9	30.5	28.2	14.1	11.7	9.4
6" Block Impregnated Vermiculite Poured	27.0	25.2	23.4	21.6	10.8	9.0	7.2
8" Block Impregnated Vermiculite Poured	25.5	23.8	22.1	20.4	10.2	8.5	6.8
12" Block Impregnated Vermiculite Poured	24.8	23.1	21.1	19.8	9.9	8.3	6.6
Light Weight Aggregate Concrete Block: 6" Block No Insulation	28.3	26.4	24.5	22.6	11.3	9.4	7.5
8" Block No Insulation	25.8	24.1	22.4	20.7	10.3	8.6	6.9
12" Block No Insulation	22.9	21.4	19.9	18.3	9.2	7.7	6.1
6" Block Impregnated Vermiculite Poured	17.6	16.4	15.2	14.0	7.0	5.9	4.7
8" Block Impregnated Vermiculite Poured	16.6	15.5	14.4	13.6	6.6	5.6	4.5
12" Block Impregnated Vermiculite Poured	16.1	15.0	13.7	12.9	6.4	5.4	4.3
CEILING							
Pitched Roof: 6" Insulation (R-19.0) Standard Ventilation	3.9	3.6	3.4	3.1	2.1	1.8	1.6
8" Insulation (R-25.3) Standard Ventilation	3.0	2.8	2.6	2.4	1.6	1.4	1.2
10" Insulation (R-31.7) Standard Ventilation	2.4	2.3	2.1	1.9	1.3	1.1	1.0
12" Insulation (R-38.0) Standard Ventilation	2.1	1.9	1.8	1.7	1.1	1.0	0.8
Hipped or Flat Roof: 6" Insulation (R-19.0) Standard Ventilation	3.4	3.2	2.9	2.7	3.1	2.6	2.1
8" Insulation (R-25.3) Standard Ventilation	2.7	2.5	2.3	2.1	2.4	2.0	1.6
10" Insulation (R-31.7) Standard Ventilation	2.3	2.1	1.9	1.7	1.9	1.6	1.3
12" Insulation (R-38.0) Standard Ventilation	1.8	1.7	1.6	1.5	1.7	1.4	1.1
Pitched, Hipped or Flat Roof: 6" Insulation (R-19.0) Controlled Ventilation	3.4	3.2	2.9	2.7	1.5	1.3	1.0
8" Insulation (R-25.3) Controlled Ventilation	2.7	2.5	2.3	2.1	1.4	1.2	0.9
10" Insulation (R-31.7) Controlled Ventilation	2.3	2.1	1.9	1.7	1.0	0.8	0.6
12" Insulation (R-38.0) Controlled Ventilation	1.8	1.7	1.6	1.5	0.8	0.7	0.5
FLOOR							
Double Wood and Crawl Space: 2" Insulation (R-7)	4.8	4.5	4.2	3.9	1.5	1.2	1.0
3½" Insulation (R-11)	3.3	3.1	2.9	2.6	1.3	1.1	0.9
6" Insulation (R-19)	2.0	1.8	1.6	1.5	0.8	0.6	0.5
Slab on Ground: 1" Insulation (R-3.5) Standard Duct System	66.8	62.3	57.9	53.4	.0	.0	.0
2" Insulation (R-7) Standard Duct System	35.8	33.4	32.6	31.8	.0	.0	.0
1" Insulation (R-3.5) Perimeter Duct	199.3	186.9	173.7	160.2	.0	.0	.0
2" Insulation (R-7) Perimeter Duct	107.4	100.2	97.8	95.4	.0	.0	.0

Note: (A) For additional factors, use the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Guide & Data Book.
(B) All above factors include correctly applied vapor barriers.
(C) Above factors are based on blanket insulation; adjust for blown material.

HEAT LOSS COMPARISON CHART[1]

Plan #274

1/1/75

BTUH

	Energy Conservation Construction		FHA Minimum Property Standards
Floor	3,178		8,722
Walls	3,665		6,495
Ceiling	2,040		4,320
Windows & Doors	3,014		13,131
Infiltration	3,449		7,854
Sub Total	15,346		40,522
Duct Loss 3%	460	15%	6,078
TOTAL BTUH HEAT LOSS	15,806		46,600

TOTAL HEAT LOSS REDUCTION = 30,794 66.08%

Cooling Comparison

Total BTUH Heat Gain (Shaded)	10,333	27,078
Design 1		
Total Heat Gain Reduction	16,745	61.8%
Total BTUH Heat Gain (Unshaded)	12,179	27,078
Design 2		
Total Heat Gain Reduction	14,899	55%

[1]From Arkansas Power and Light Load Calculation Forms at 70° TD Heating and 25° TD Cooling.

In Designing an energy conserving house it is essential to recognize the high energy cost of windows and doors. Much of the infiltration shown also occurs around windows and doors. In the energy conserving home, windows were reduced to 8% of living area which was 5.3% of the total 1200 sq. ft. area of the house. (In the MPS house the windows equalled 10.7% of the total house area). Cutting window area by 5.4% and adding storm windows accounted for over 20% of the energy savings.

The actual results were close to the calculations for cooling 61.8% versus actual of 63.5% In the heating period, savings were greater than calculated: 66.08% calculated, 80.6% actual. We have not found a reliable way to calculate for human variation in living styles. Nor do standard heat loss calculations factor the solar heat contributed through windows on sunny winter days. The estimated heat contributed by 6 people was included in the calculations but nothing in the standard calculations includes additional heat contributed by such activities as cooking, clothes drying, water heating, and heat contributed by other equipment. In an energy efficient home such heat reduces the amount of heat required from the heat pump. One would expect in summer these same factors would add to the air conditioning load. Perhaps because of todays trend to outdoor cooking and more outdoor living in summer the extra cooling load contributed by equipment in summer is less than is contributed towards heating in winter.

SUPPLEMENTARY DATA FOR BROADER TEMPERATURE RANGE

HEAT TRANSFER FACTORS (HTF)

DESIGN TEMPERATURE DIFFERENTIAL (TD)	HEAT LOSS					HEAT GAIN				
	80°	75°	70°	65°	60°	30°	25°	20°	15°	10°
WINDOWS (Weather stripped)										
Single Pane	90.5	84.8	79.1	73.5	67.8	31.8	26.5	21.2	15.9	10.6
Insulating Glass	48.9	45.8	42.7	39.7	36.6	18.3	15.3	12.2	9.1	6.0
Triple Glazed	33.6	31.5	29.4	27.3	25.2	12.6	10.5	8.4	6.3	4.2
DOORS (Weather stripped)										
Hollow Core	90.5	84.8	79.1	73.5	67.8	31.8	26.5	21.2	15.9	10.6
Solid Core (1-3/4")	38.4	36.0	33.6	31.2	28.8	14.4	12.0	9.6	7.2	4.8
Solid Core (1-3/4") & Storm Door	24.9	23.3	21.7	20.2	18.6	9.3	7.8	6.2	4.6	3.0
Therma-Thru (Urethan/Steel R-13.8)	5.9	5.5	5.1	4.7	4.3	2.2	1.9	1.5	1.1	0.7
INFILTRATION (Doors & Windows)										
Without Storm Sash or Door	39.0	36.5	34.0	31.6	29.2	14.6	12.2	9.7	7.2	4.7
With Storm Sash or Door	25.3	23.7	22.1	20.5	19.0	9.5	7.9	6.3	4.7	3.1
WALLS										
3-1/2" Insulation (R-11)	6.4	6.1	5.8	5.3	4.9	2.5	2.1	1.7	1.3	0.9
6" Insulation (R-19)	4.2	3.9	3.6	3.4	3.1	1.6	1.3	1.1	0.9	0.7
CEILING										
6" Insulation (R-19.0)[1] Standard Ventilation	4.2	3.9	3.6	3.4	3.1	2.1	1.8	1.6	1.4	1.2
12" Insulation (R-38.0)[1] Standard Ventilation	2.3	2.1	1.9	1.8	1.7	1.1	1.0	0.8	0.6	0.4
6" Insulation (R-19.0)[2] Standard Ventilation	3.6	3.4	3.2	2.9	2.7	3.1	2.6	2.1	1.6	1.1
12" Insulation (R-38.0)[2] Standard Ventilation	1.9	1.8	1.7	1.6	1.5	1.7	1.4	1.1	0.8	0.5
6" Insulation (R-19.0)[3] Controlled Ventilation	3.6	3.4	3.2	2.9	2.7	1.5	1.3	1.0	0.7	0.4
12" Insulation (R-38.0)[3] Controlled Ventilation	1.9	1.8	1.7	1.6	1.5	0.8	0.7	0.5	0.3	0.1
FLOOR										
2" Insulation (R-7)	5.1	4.8	4.5	4.2	3.9	1.5	1.2	1.0	0.8	0.6
6" Insulation (R-19)	2.2	2.0	1.8	1.6	1.5	0.8	0.6	0.5	0.4	0.3
2" Insulation (R-7) Standard System	38.2	35.8	33.4	32.6	31.8	.0	.0	.0	.0	.0
1-1/2" Urethane Foam Insulation Standard System (R-10.7)	23.9	23.3	22.7	22.1	21.5	.0	.0	.0	.0	.0

Note: (A) For additional factors, use the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Guide & Data Book.
(B) All above factors include correctly applied vapor barriers.
(C) Above factors are based on blanket insulation; adjust for blown material.

Key: [1]Pitched roof [2]Hipped and flat roof [3]Pitched, hipped and flat roof

ENERGY CONSERVING HOMES

Total metered energy use includes sub-metered heating and cooling use.
Cost of heating and cooling at 1975 A.P. & L. Co. rates of 2.5¢ per KWH cooling, 2¢ per KWH for heating.

Home Description	May to October Cooling Season				November to April Heating Season				12 Month Totals					
	Total Usage		Cooling & Defrost		Total Usage		Heating		Total Usage		Heating & Cooling		Days Covered	Monthly Average Cost for Heating & Cooling
	KWH	Cost	KWH	Cost	KWH	Cost	KWH	Cost	KWH	Cost	KWH	Cost		
A. 5 occupants, 1344 sq. ft. 3 bedrooms, 2 baths, 1 living room, and 1 den Builder: Rex Rogers Construction Company	11,111	$317.92	3,852	$96.32	9,470	$270.77	2,119	$42.38	20,581	$588.69	5,971	$138.70	363	$11.56
B. 2 occupants, 1200 sq. ft. 3 bedrooms, 1 living room Builder: Wilson Porter	8,620	$215.50	2,806	$70.15	6,634	$132.68	3,663	$73.26	15,254	$348.18	6,469	$143.41	377	$11.95
C. 4 occupants, 1200 sq. ft. 3 bedrooms, 2 baths, 1 living room Builder: Hugh Bragg	9,009	$225.23	3,050	$76.25	8,847	$177.48	1,749	$34.98	17,856	$402.71	4,799	$111.23	350	$ 9.27
D. 3 occupants, 1200 sq. ft. 3 bedrooms, 2 baths, 1 living room Builder: Hugh Bragg	9,413	$235.33	3,669	$91.73	8,255	$165.10	2,734	$54.68	17,668	$400.43	6,403	$146.41	350	$12.20

Four House Averages per Month:

Cooling	Heating	Total C & H
$13.94	$8.55	$11.24

Heating and Cooling Equipment. House A, Marion, Arkansas: 1½ Ton Heat Pump; House B, North Little Rock, Arkansas: 1½ Ton Furnace and 6 KW Compressor; Houses C and D, Benton, Arkansas: 2 Ton Heat Pumps.

COMPARATIVE DATA BASED ON 12 MONTHS METERED DATA, TOTAL ELECTRICAL USAGE

11 MPS CONSTRUCTED HOMES, AVERAGING 1296 SQ. FT., 2½ Ton Furnaces with Compressor

(Heating and cooling was not metered Separately)

Home	A	B	C	D	E	F	G	H	I	J	K
[1]Total 12 Mos Energy (KWH)	31,332	38,133	31,862	39,922	39,018	31,317	32,552	28,929	32,983	44,023	43,162
[2] 6 Mos Cooling Season	13,727	16,721	14,142	18,884	16,047	13,535	13,197	10,759	14,282	22,289	20,619
[3] 6 Mos Heating Season	17,605	21,412	17,720	21,038	22,971	17,782	19,355	18,170	18,701	21,734	22,543
[4]Actual Total Year Billing	$790.28	$939.46	$802.56	$986.56	$953.33	$791.96	$813.84	$728.30	$828.21	$1084.42	$1057.69

Average Annual billing 11 homes	35,750 KWH
Average for cooling season	15,838 KWH
Average for heating season	19,912 KWH

COMPARISON OF ENERGY USE AND SAVINGS FOR TWELVE MONTHS

FOUR METERED ENERGY CONSERVING HOMES VS. ELEVEN METERED MPS HOMES

Because the heating and cooling energy use was only metered separately in the four energy conserving homes but not in the eleven MPS homes, no verifiable direct comparison of heating and cooling costs can be made. However, because the total energy use for the energy conserving homes was 46.7% less it can be assumed this difference was majorly because of heating and cooling savings. We can get some indication of the savings in heating and cooling if we assume that the average use of energy other than heating and cooling was the same for the MPS homes as the average for the energy conserving homes. We also need to recognize that the MPS homes averaged 5% greater square footage than the energy conserving homes, so we have reduced the MPS home total usage by 5% for comparative purposes. Here then is a summary of savings based on these assumptions.

ACTUAL METERED TOTAL ENERGY SAVINGS AND INDICATION OF SAVINGS IN HEATING AND COOLING

	Average for Four Energy Conserving Homes	Average for 11 MPS Homes	5% Adjustment* Average for 11 MPS Homes	% Saving ECH Over MPS Adjusted
Total Energy Consumption	Avg. from metered usage			
Cooling Season KWH (May-Oct)	9,538	15,838	15,045	36.6%
Heating Season KWH (Nov-Apr)	8,558	19,912	18,916	54.8%
Total 12 Months KWH	18,096	35,750	33,962	46.7%
Heating and Cooling	Avg. from metered usage	Estimated heating and cooling assuming other use equal.		
Cooling Season KWH (May-Oct)	3,344 (6,194 other use)	9,644	9,162	63.5%
Heating Season KWH (Nov-Apr)	2,566 (5,992 other use)	13,920	13,224	80.6%
Total 12 Months KWH	5,910 (12,186 other use)	23,564	22,386	73.6%

Since different rates prevailed in different areas, a cost comparison would not be valid.

*To equalize house size

C O S T S O F E N E R G Y C O N S E R V A T I O N H O M E C O N S T R U C T I O N

One would expect a house that saves 63% to 74% in heating and cooling costs to be more expensive to build. Particularly because this house offers additional benefits and equipment--humidification, dehumidification, electronic air filtering, power attic ventilation and sound insulation. In reality, four builders who have built several of these homes say it costs less than conventional MPS construction. In view of the extra costs of modified trusses, extra equipment and more insulation, how can the house cost less?

The answer seems to be that most of the savings are achieved through a combination of less materials, fewer pieces and consequently, faster construction. Let's look at some of the techniques that lead to these construction savings. Taking the Plan 274 house, shown on page 14 , and comparing the Arkansas house framing construction[1] with standard 2" x 4", 16" o.c. construction, the energy conserving home uses 343 pieces of lumber versus 590 pieces for the MPS house. This is 42% less material to handle, cut and nail--2,050 board feet versus 3,254 board feet of lumber[2] to buy and, in some areas, at a lower cost per board foot[3]. Part of the secret of these savings is in the use of back-up clips to replace backing boards and eliminate T's in the walls. This method of installing the gypsum board serves another important function; it enables the eliminated studs and boards to be replaced with insulation, and importantly, allows insulation to be placed right into the corners of the house which are normally uninsulated. The 2" x 6" construction provides room for installing R-19 Fiberglas batts in all stud spaces and permits placing insulation behind outlet boxes. In addition, due to the post and beam construction, not only are single top plates used instead of double[4] plates, but headers are not required in partition doorways. Even in external walls plywood headers can, in under 48" openings, be used to replace 2" x 8" headers. The use of prefabricated modified trusses also saves time.

Another saving is achieved by cutting V's in the bottom of studs to provide a wiring raceway. Designed to keep the Romex from interfering with and complicating insulation installation, it turns out that this system also saves the electrician hours of labor normally necessary for hole cutting. Precutting the V's is much faster and easier.

Another saving is in confining the plumbing to a relatively small rectangle. The purpose is to reduce the length of hot water lines and by reducing heat loss, lower the cost of water heating, an expensive portion of the monthly utility bill. What this also does is reduce the amount of piping materials and reduce the time needed for installation. Because the energy conservation measures lower total heat loss and gain, the size of the heat pump can be reduced from possibly 3 tons to 1½ or 1 ton. This saves a sizable amount and provides the added benefit of reducing other heating and cooling components in proportion to the reduction in heat pump capacity.

For example, electrical service to the house can possibly be reduced, from perhaps 200 amps to 150 amps or even 100 amps. This can mean fewer buss bars, less wiring. Using all electric service saves the need to provide two utility connections, a considerable saving in piping, meters and their installation. A corollary benefit is that with the better insulated walls conditioned air can be supplied perfectly satisfactorily through proportionately smaller, shorter ducts in a dropped ceiling through the center hall. For this size home no return ducts are necessary. Because the ducts are inside the conditioned space no insulation is required unless some duct liner is desired for noise absorption.

In the attic, gable vents are replaced by generally less expensive soffit vents.

The smaller windows while they reduce header requirements and usually need no jack studs, probably cost about the same because storm or insulated windows are required. The insulated steel front doors are reported to be about the same cost installed as standard solid doors plus storm doors, but provide much greater thermal and infiltration resistance.

The saving in total construction time, as much as five days[5], also reduces the interest cost on the construction loan. Other savings such as the use of the quickly installed Fiberglas tubs and showers are up to each individual builders own ingenuity. To maximize his potential savings the builder may have to locate sub-contractors willing to adjust to these energy conservation requirements. Sub-contractors willing to help provide homes people can afford to buy and live in, to assure a resurgence in housing construction. He must buy intelligently, schedule to capitalize on the time savings, be thoroughly familiar with the house plans and know more than his sub-contractors about the energy conservation requirements. He must supervise continually to prevent waste and avoid having one contractor undo the work of another. He will be well advised to explain the energy saving features to the code officials and building inspectors and ask their help in staying close to the job to prevent schedule hold ups. You'll find code people are as interested as you are in saving the nation from future energy shortages.

Rex Rogers, who has built over fifty of these homes advises that you probably will not save money on your first house or two. It takes experience to maximize the savings by scheduling and to avoid waste. In the NAHB Mod 24 book it remarks, that given the chance, a framer finding enough room between two studs for a canary to fly through, will throw in another stud.

In an energy saving home, extra studs only add to waste of time, material and, in the outside wall, to energy waste. Wood insulates but not anywhere near as effectively as the same space filled with insulation. Economy of materials and means is the secret of lower construction costs.

A recently published report by Ralph Johnston gives added independent confirmation that this type of construction can save money.[6] Whether it will save more or less than the added cost items may well depend on local material and labor costs and restrictive code requirements. But if you'll look for the savings as readily as you note the extra cost you will in most parts of the country save money. If you need help to get code approval, local construction specialists of the National Forest Products Association and Western Plywood Association will be glad to provide code officials with supportive test data on the safety and strength of the construction system.

The Arkansas specifications were developed through fifteen years of trial and error. The system has been endorsed by dozens of builders who have followed the specifications. While its natural instinct to want to improve on everything, those who have tried advise, be sure you think through all the eventual consequences before you make changes.

[1]24" o.c. stud placement with 2" x 6" studs around the 1200 sq. ft. living area, 2" x 4" garage walls, 2" x 3" partition walls with single top plates.

[2]Frank Holtzclaw making an independent calculation reported the energy conserving home savings in lumber was 41% and even compared to 2" x 4" on 24" center construction, offered a 35% savings, due to the reduced T's, jack studs, headers and double top plates.

[3]See Page 47.

[4]In two story construction, double top plates are required for the first floor but not for Plan 274 being discussed.

[5]See Report No. 2. An Energy Conserving Home in Hartford, Connecticut.

[6]See page 49

RATIONALE FOR THE DESIGN OF THE THERMALLY EFFICIENT HOME

We choose to live in homes because we can protect ourselves from the elements, control our environment, enjoy comfort and privacy with security for our possessions. In the past, we have had to accept compromises, based on finances between initial cost and operating cost, size and comfort.

It has been assumed for many years that gaining complete control over a home's environment to achieve maximum comfort would be very expensive initially. The truth is, that comfort and energy economy are wedded together, as the Arkansas construction proves.

The rise in energy costs has now made home buyers more accutely aware of the fact, that operating costs over the mortgage life of the home can be far larger than the cost of the insulation and other steps necessary to reduce those operating costs particularly heating and cooling costs.

Almost every home built in the United States up to the present time has been built with insufficient insulation for today's energy costs and provides far from optimum comfort. Unfortunately, once built, a home can not economically be completely renovated to achieve maximum economy, although improvements in energy conservation can be achieved by adding attic and crawl space insulation, storm doors, caulking windows, etc. Since these existing conventional homes were designed on thermo-dynamic calculations ignoring the harder to measure physiological factors recognized in Arkansas, they are never likely to provide the comfort and economy of the Little Rock thermally efficient test homes.

WHAT IS REAL COMFORT?

Comfort is not only a very important benefit of a thermally protected home, it is a necessary condition to the realization of the saving of fuel, and of money. Therefore, it is important that we become aware of the meaning of Real Comfort.

Real, of course, means actually existing. Comfort is a condition. For a better explanation, Real Comfort can be referred to as the Ideal Comfort Level.

First: The individual or occupant must be considered. Because the average, healthy human body, even when asleep is a "heat producing Machine", it follows that the problem of establishing a comfortable environment is not one of supplying heat, but rather controlling the rate at which the individual loses heat.

Second: The conditioned space must be considered. The fundamental purpose of a heating system is to supply heat to the occupied space and not to the occupant.

For the occupant to be really comfortable the Ideal Comfort Level must be maintained. We must be assured of the following:

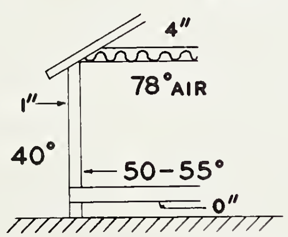
1. Controlled Effective Temperature
2. Controlled Humidity
3. Controlled Air Circulation

Effective Temperature is controlled primarily with thermal protection. (Insulation, Storm Windows & Doors, Vapor Barriers, Weather Stripping, etc.) The elimination of all the cold surfaces in winter and warm surfaces in summer is an absolute must to the attainment of Ideal or Real Comfort since our bodies radiate to cold surfaces and warm surfaces radiate to our bodies, consequently a well insulated home is the only truly comfortable home. (This would apply to any space.)

Assuming our air conditioning is properly designed and we have the proper humidity level with a minimum of air movement, here are examples of various comfort (or discomfort) levels in the same type home with varied degrees of Thermal Protection. The comfort level can also be referred to as the effective temperature or the temperature that the body senses.

Well Constructed Home with:

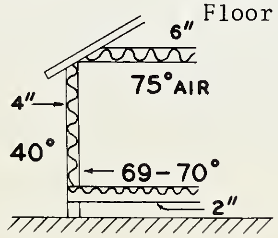
Example #1. Ceiling - 4" Insulation and approved vapor barrier
Walls - 1" Insulating board



$$\begin{array}{r} 78^{\circ} \\ +55^{\circ} \\ \hline 133^{\circ} \end{array} \qquad 2\,\overline{)\,133^{\circ}}\;=\;66.5^{\circ}$$

Effective Temperature Level 66.5°

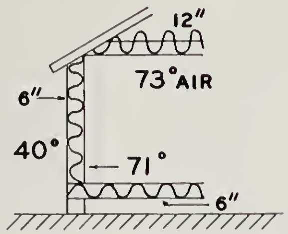
Example #2. Ceiling - 6" Insulation and approved vapor barrier
Walls - 4" Insulation and approved vapor barrier
Floor - 2" Insulation and approved vapor barrier



$$\begin{array}{r} 75^{\circ} \\ +69^{\circ} \\ \hline 144^{\circ} \end{array} \qquad 2\,\overline{)\,144^{\circ}}\;=\;72^{\circ}$$

Effective Temperature Level 72°

Example #3. Ceiling - 12" Insulation and approved vapor barrier
Walls - 6" Insulation and approved vapor barrier
Floors - 6" Insulation and approved vapor barrier



$$\begin{array}{r} 73^{o} \\ +71^{o} \\ \hline 144^{o} \end{array} \qquad 2\,\overline{)\,144^{o}} = 72^{o}$$

Effective Temperature Level 72^{o}

It should be noted that in these examples the comfort level was attained only by assuming the proper humidity level with a minimum of air circulation, then we averaged the exterior wall temperature and the air (space) temperature.

One very important factor should be noted "as the thermal protection was increased the wall temperature raised as the air (space) temperature decreased." Excessive air temperatures are not necessary for comfort and are only needed to offset cold walls--high air temperatures and cold walls (interior surfaces) are sure to create discomfort, the reverse with low air temperatures and warm walls can produce poor comfort conditions in summer.

At this point there is only one conclusion to be made; Comfort is the prime benefit received from complete thermal protection (insulation, storm sash, and vapor barriers). It follows that the homeowner will receive a more economical operation, a lower equipment cost (these savings will more than pay for complete thermal protection), and the final result will be a much lower owning and operating cost.

As mentioned earlier the human body is a "heat producing machine" and we must control the rate at which the heat is dissipated. Our body loses heat through Radiation (radiating to a colder surface), through Convection (loss of heat by air moving over the skin surface), and through Evaporation of moisture from the pores of the skin. By controlling the relative humidity we can retard or increase the rate our body loses its heat through evaporation. Increasing the humidity to 40-50% in winter we retard the rate of loss and by decreasing the relative humidity to 30-40% in summer we increase the body heat loss rate.

Controlled Humidity permits us to maintain lower winter air temperatures and higher summer air temperatures in our conditioned space while enjoying better comfort using less fuel and reducing operating cost.

Air circulation or air movement must be held to a minimum. Excessive air movement causes drafts which in turn cause discomfort; therefore, the amount of air, the velocity of the air must be controlled to provide the exact volume needed in each room or space. The amount of air is determined by the heat load of each room.

Why is a Comfortable Condition absolutely necessary? Simply explained, if the occupant of our space becomes chilled from cold feet on cold floors or from the chilling effect of a draft he or she will turn up the thermostat. In the summer this process is reversed since an occupant in close proximity to a warm surface will become too warm and turn down the thermostat. In a poorly insulated home or building this aggravates the already high operating cost. A good many people operate their thermostat as though it were an accelerator, trying to speed up a hopeless situation. This is not likely to happen in an Ideal Comfort Level Home.

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6600 Geyer Springs Road
Little Rock, Arkansas 72209

PROFESSIONAL BUILDER SURVEY OF ACTIVE HOMEBUYERS

HOME BUYERS WILLING TO INVEST IN ENERGY CONSERVATION

Q. Suppose a builder told you that by spending $600 more at the time of construction, he could cut your heating and cooling bills by $100 per year. What would be your reaction?

	Total %	% Active Buyers Region East	Central	South	West
Spend the additional $600	80.5 } *	84.4	88.0	77.8	71.8
I'd be willing to spend even more to save more	8.8 } *	9.4	6.0	13.3	5.6
Not spend the $600 because the savings takes too long to recover	3.9	1.6	3.6	3.3	7.0
Not spend the $600 because the savings are not believable	6.2	3.1	2.4	5.6	14.1
*Willing to spend $600 or more	89.3				

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FRANK HOLTZCLAW CALCULATIONS SHOWING LUMBER SAVINGS IN FRAMING 1200 SQ. FT. PLAN 274 HOUSE WITH SINGLE CAR GARAGE (660 sq. ft.)

ARKANSAS ENERGY CONSERVING HOUSE STUDS 24" o.c. WITH POST AND BEAM CONSTRUCTION.

			Board Feet
71	-	2 x 3 - 8' studs = 2 x 3 - 568' =	284
61	-	2 x 4 - 8' studs = 2 x 4 - 488' =	325
80	-	2 x 6 - 8' studs = 2 x 6 - 640' =	640
		2 x 2 sole & top plate = 16 lf x 2 = 32 lf =	11
		2 x 3 sole & top plate = 106 lf x 2 = 212 lf =	106
		2 x 4 sole & top plate = 78 lf x 2 = 156 lf =	104
		2 x 6 sole & top plate = 149 lf x 2 = 298 lf =	298
2	-	2 x 12 - 10' gar. door header = 2 x 12 - 20 lf =	40
		TOTAL	1808

SAME HOUSE CONSTRUCTED TO CONVENTIONAL FHA STANDARDS 2" x 4" - 16" o.c.
2 x 4 - 16" o.c.

Exterior Walls = 199 lf = 1.05 x 8.08 = 8.48 x 199 =	1688
Interior Walls = 135 lf = 1.12 x 8.08 = 9.05 x 135 =	1222
Interior Walls 2 x 6 = 16" o.c. = 1.48 x 8.08 = 11.96 x 8 =	96
2 - 2 x 12 - 10' gar. door header = 2 x 12 - 20 lf =	40
TOTAL	3046

ARKANSAS ENERGY CONSERVING HOUSE REQUIRES:

41% less framing lumber in all walls

Compared to:

FHA @ 2 x 4 - 24" o.c., THE ENERGY CONSERVING HOME REQUIRES

34% less framing lumber.

(Note: The ECH uses back up clips eliminating T's, single top plates and 2" x 3" non load bearing partitions that do not require headers. Single studs either side of smaller windows usually without jack studs)

THE ELECTRICITY COUNCIL CENTRE

Capenhurst, Chester Ch 16 ES, England.

ECRC/N723

THE EFFECTS OF ADDED CLOTHING ON WARMTH AND COMFORT IN COOL CONDITIONS

by

D. A. McIntyre and I. D. Griffiths

SUMMARY

Forty subjects were exposed to two ambient temperatures, 15 and 19°C, both of which are below the optimum temperature for sedentary subjects. They described their feelings of warmth and discomfort on five seven-point rating scales. An added woolen sweater over their clothes increased the mean warmth vote by 0.7 of a scale interval; this is equivalent to raising the temperature by about 2°C. The rating of discomfort did not change i.e. while the added sweater made people warmer, it did not alleviate their discomfort. The feelings of discomfort were apparently associated with cold feet. In general, therefore, it is not possible to compensate for low ambient temperatures by added clothing without reducing the standard of comfort.

This Note is published as part of the Electricity Council's Research Programme and any technical query on the contents or requests for permission to reproduce any part of it should be addressed to the Authors. May 1974

Super Insulation Systems Keep Energy Cost Down

Wherever the home, whatever the fuel, constantly climbing energy costs are making amounts of insulation far beyond past recommendations economically feasible and desirable. To accommodate insulation with thermal resistance values of R-38 or R-30 in ceilings and R-16 to R-19 in walls, combinations of insulation developments and design innovations have resulted in three major new "Super Systems."

A Super System consists of either increasing available space to permit installation of thicker insulation or using insulation materials that provide higher thermal resistance within the same space. Super Systems produce substantial savings in heating and cooling costs at remarkably small increases in construction investment.

Techniques include the use of 2 x 6 studs on 24" centers in place of conventional 2 x 4 studs on 16" centers to allow application of R-19 mineral wool batts.

In Optimum Value Engineered framing, studs, trusses, and floor joists are spaced 24" o.c. Loads are concentrated in line vertically. Single plates are adequate; the bottom plate is nominal 1" lumber. Doors and windows are positioned with one side at a modular stud location. Two studs, not three, are used at corners, with one piece of drywall backed by metal clips.

Reprinted from *The National Mineral Wool Insulation Association Reporter*, April, 1976.

Innovations in Home Building Methods Set New High Levels of Money-Saving Performance

Super System I: Make Sidewalls Thicker

With an advanced framing technique, sidewall framing with 2 x 6 studs actually can be less expensive than conventional 2 x 4 framing. Taking into consideration both material and labor costs, an analysis by the NAHB Research Foundation showed an $18 saving for a 1,200-square-foot home. With R-19 mineral wool insulation costing $40 to $45 more than R-11, the net additional cost of this Super System averaged only $22-$27. (Material costs and labor rates were as of October, 1974.)

At zero-degree design temperature, the system reduces heat loss an additional 2,000 Btu/hour, compared with R-11 insulation. Ralph J. Johnson, staff vice president of the Research Foundation, has estimated annual savings in a climate such as Chicago's in excess of 6 million Btu. The simple payback period for the improved thermal performance would be 1-1½ years.

Savings in framing costs accruing to 2 x 6 construction result primarily from lower labor requirements. The Research Foundation analysis showed material costs for conventional 2 x 4 framing, 16" o.c., averaging $205.14 for a 1,200-square-foot, one-story house, and labor costs averaging $141.07. These figures were based on material costs of $168/MBF for stud grade 2 x 4's and an average carpenter rate of $9.33/hour. Using the Optimum Value Engineered framing techniques developed by the foundation for Operation Breakthrough, 2 x 6 framing 24" o.c. averaged $220.49 in materials and $107.48 for labor. The base cost for #3 grade 2 x 6's was $172/MBF.

Total in-place cost of the two techniques was $346.21 for conventional 2 x 4 framing, 16" o.c., and $327.97 for O.V.E. 2 x 6 framing, 24" o.c.

Adding an upstairs to the same 26' x 46' home, the Research Foundation analysis reported total in-place cost of the 2 x 6 O.V.E. framing as $662.86, against $718.73 for conventional 2 x 4 framing — a saving of nearly $56.

With double the sidewall area, the additional cost of R-19 insulation over that of R-11 also would be double that for the single-story home, or $80 to $90. The net additional cost of the Super System in the two-story version is only $25-35.

OWENS-CORNING FIBERGLAS AIDS IN BUILDING

ENERGY CONSERVING HOMES.

Additional "Energy Conserving Ideas To Build On" Reports.

- Number 2 Energy Saving Home in Connecticut ...Economies of Truss Construction.
- Number 3 Energy Saving Homes in Satsuma, Alabama...A design for southern comfort.
- Number 4 Energy Saving Homes in Greenwich, New York...Economy in cool climate heating.
- 44 Ways to Building Energy Conservation into your home
- Insulation -- The Basic Energy Saver
- EPM (Energy Per Month) Builders' Promotion Package.

Where to Get More Data on Energy Conservation

The bibliography of publications about insulation and the building industry is growing, and much of the source material is readily available to builders.

- "Do You Have Money to Burn" Harry A. Tschumi, 6600 Geyer Springs Road, Little Rock, Arkansas, 72209. The originator of the Arkansas House explains the concept of creating comfort to reduce energy use and cost. Price $3.00, check with order.

Among the available government publications are:

- Technical Options for Energy Conservation In Buildings, U.S. Government Printing Office, Washington, D.C., 20402 (order no. C13.46:789, price $2.35).
- Making The Most of Your Energy Dollars In Home Heating and Cooling, U.S. Government Printing Office, Washington, D.C., 20402, (order no. C13.53:8, price 70¢).
- 11 Ways To Reduce Energy Consumption And Increase Comfort In Household Cooling, U.S. Government Printing Office, Washington D.C., 20402, (order no. C13.2EN 2, price 40¢).
- In the Bank...Or Up The Chimney? U.S. Government Printing Office, Washington, D.C. 20402 (Stock No. 023-000-00297-3, price $1.70).

Copies of the FHA Minimum Property Standards can be obtained at any local FHA office.

The National Association of Home Builders' (NAHB) Insulation Manual is under revision--a revision necessitated in part by the increase in fuel costs. For information on the new edition contact the National Association of Homes Builders Research Foundation Inc., PO Box 1627, Rockville, Md. 20850.

Another NAHB publication of interest to builders involved with construction of energy efficient homes is:

- The Builders Guide to Energy Conservation, NAHB, 1625 L St., N.W., Washington, DC. 20036.

While it doesn't make for bedside reading, ASHRAE Standard 90-75, Energy Conservation In New Building Design, may be the most important publication about insulation and energy conservation yet written.

- Copies of ASHRAE Standard 90-75 may be ordered through ASHRAE Publications Sales Dept., 345 East 47th St., New York, NY 10017. Price for nonmembers is $10 and $5 for members of the American Society Of Heating, Refrigerating, and Air Conditioning Engineers.

The National Mineral Wool Insulation Association, 382 Springfield Ave., Summit, NJ, 07901, has the following energy booklets available:

- Interpretations of HUD-FHA Building Insulation Standards.
- How to Insulate Homes For Electric, Gas or Fuel Oil Heating (specify heating system).

HOUSE PLANS FOR ENERGY CONSERVING HOMES.

The Plan Shop, Inc.
4750 McWillie Drive
McWillie Plaza
PO Box 16332
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Five ranch and two story plans from 1200 sq. ft. all designed with a unit heat loss from 13.1 to 15.3 BTUH/sq. ft.

National Plan Service, Inc.
435 W. Fullerton Ave.
Elmhurst, Illinois 60126
(312) 833-0640

Sixteen different energy conserving home plans, in all styles, from 900 sq. ft. to 2200 sq. ft. with or without basement and eight available with wood foundation option.

C R E D I T S

We are indebted to the following people and their organizations for their help in assembling the data in this report. Those who as a result of the Arkansas Demonstration in Energy Conservation are able to build a home to these new high standards of comfort and economy owe an especial debt to the late Mr. Les Blades of the Arkansas Power and Light Company who, together with Mr. Harry Tschumi, President of Harry Tschumi Company pioneered the concept, conducted the initial research and helped overcome the apathy, and resistance to change that continually thwarted their efforts.

Mr. Frank Holtzclaw designed the energy conservation homes that not only proved the assumptions correct but, permitted the construction of an energy conserving home at no increase over the cost of a conventional home.

We are also grateful to the many homeowners, builders, manufacturers and utilities in Arkansas and other states who have contributed their knowledge, experience and confirming data to assure accuracy of reporting. We also wish to acknowledge the support of the trade press and local home builders associations for their help in bringing the concept of energy conserving homes to the attention of home builders and their subcontractors.

Arkansas Power and Light Company
- Fred Clark
- Fred Johnson
- Bob G. Haynie

Harry Tschumi Company
- Harry Tschumi, President

HUD, Little Rock Regional Office
- Andy Watts, Acting Deputy Area Director
- Frank Holtzclaw, Senior Construction Analyst

Rex Rogers Construction Company
- Rex Rogers, President

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Insulation Operating Division
Fiberglas Tower, Toledo, Ohio 43659

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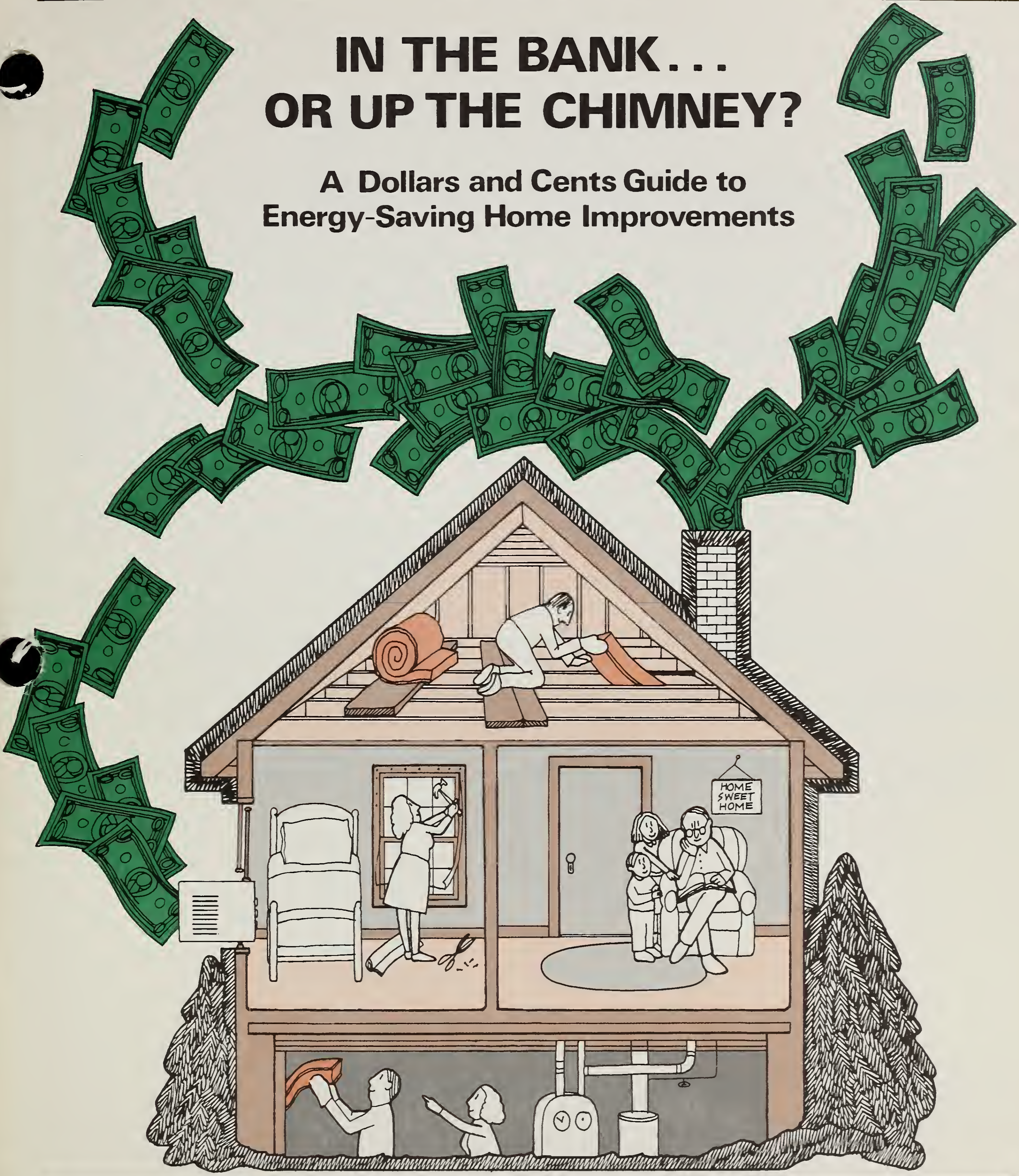
2nd EDITION

IN THE BANK... OR UP THE CHIMNEY?

A Dollars and Cents Guide to Energy-Saving Home Improvements



Energy Conservation Now

Department of Housing and Urban Development

Preface

To the American Homeowner:

I am sure you are aware that heating and cooling your home is costing more money than ever before. This does not have to be true. There is clear and reliable information to help you put dollars in the bank instead of up the chimney.

The results of HUD-sponsored research on the many ways to save energy and money while heating and cooling your house are described in this booklet.

It doesn't matter whether your house is built of brick, wood or other material. HUD has included energy-saving techniques applicable to all types of housing, and from the explanations in this booklet, you will be able to choose the best methods for your house. This booklet will also help you choose between those energy-saving steps you can do for yourself and those you will want to hire a contractor to undertake. Tables are provided to enable you to compute the cost-savings of each method.

We at HUD believe this booklet is very useful. We hope that you will use it to save money and energy for your family and the Nation.

Patricia Roberts Harris
Secretary

IN THE BANK...
OR UP THE CHIMNEY?

A Dollars and Cents Guide to Energy-Saving Home Improvements

2nd EDITION

Prepared for the

Office of Policy Development and Research,

Division of Energy, Building Technology and Standards,

U.S. Department of Housing and Urban Development

Under Contract H-2179R by

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Cambridge, Massachusetts
April 1975

Revised under Contract H-2681 by

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Cambridge, Massachusetts

August 1977

For sale by the Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

Stock No. 023-000-00411-9

Financing Energy-Saving Home Improvements

HUD/FHA-insured "Title I" home improvement loans can be used to finance energy saving home improvements (see page 66). Contact your bank or local HUD Office for information on terms and amounts.

Tax Credits

At the time of this publication, federal tax credits to benefit homeowners who make energy-saving investments had not yet been enacted. However, in the near future this situation is almost certain to change, making the improvements described here even more financially attractive. There will be a limit to those credits; we hope this manual will serve as a tool to help you make the most of them, both in terms of fuel dollars you save, and in terms of energy saved for the nation. Be sure to check with the local office of the Internal Revenue Service before applying for a tax credit for energy saving improvements.

More Information

A more detailed, technical presentation of the material in this manual is available, and is recommended for use by contractors, architects, and engineers, Enclose $7.50 for paperbound, $3.00 for microfiche, and write for "Cost-Effective Methods to Reduce the Heating and Cooling Energy Requirements of Single-Family Dwellings," Stock Number PB241919:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22151

More Copies of this Manual

If you think your company, organization, or department would be interested in obtaining quantities of "IN THE BANK. . .OR UP THE CHIMNEY?", information on getting discounts for orders in quantity is available. In addition, information on using this manual as a promotional device, or in energy education programs is also available. Write:

Office of Policy Development and Research
Division of Product Dissemination and Transfer
U.S. Department of Housing and Urban Development
451 7th Street, S.W., Room 8126
Washington, D.C. 20410

CONTENTS

HOW TO USE THIS MANUAL

TWO WAYS TO BEGIN

Whether you begin with Part 1 or Part 2, you won't have to read all of it – just what applies to your home.

1. Take a Quick Look at Your Home

Start on page 2...

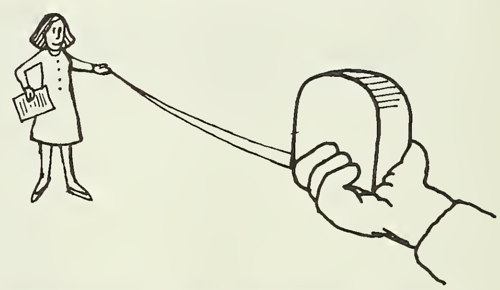
. . . to look at your home from your armchair – you don't have to measure or count a thing. Depending on where you live and whether or not you have air conditioning, Part 1 will tell you what your best energy-saving steps are. You'll get a rough idea of what they'll cost, and how much they'll save you each year.

OR

2. Take a Closer Look

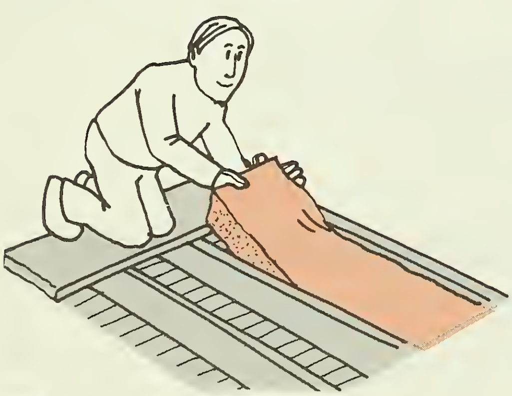
Start on page 7...

. . . if you're willing to count your windows, make some quick measurements, and do a little arithmetic. Part 2 will tell you much more than Part 1. It's tailored to your home – and it'll give you a pretty good idea of your costs and savings for each energy-saving home improvement.



THEN ... DO IT!

Go on to page 33...



. . . each energy-saving home improvement you've chosen is spelled out in detail. You'll find out how to do-it-yourself; or, how to hire a contractor and see that he does the job right.

There's More, too...

Page 69...

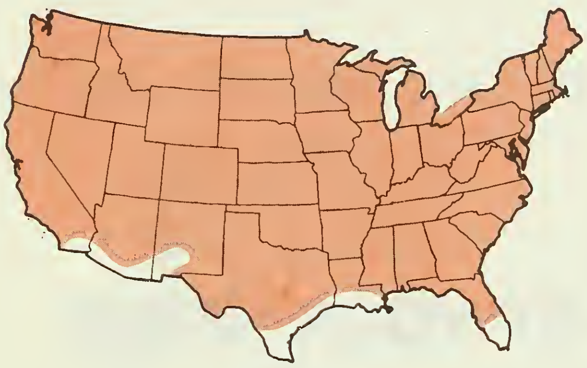
Part 4 has lots more ways to save energy – and some new ways to come in the future.

PART 1: A QUICK LOOK AT YOUR HOME

PART 1: A QUICK LOOK AT YOUR HOME

There are ranges of costs and savings given for the energy-savings improvements on these two pages. For comparison with your home, a single-story, 1250 square-foot house in Washington, D.C. paying $.45 per gal. of oil, $.16 per hundred cubic feet of gas, or $.03 per kilowatt of electricity will fall at about the middle of the range given.

YOUR HEATING SAVINGS



You can save significantly on heating if you live practically anywhere in the U.S.A.

Look at the map above.

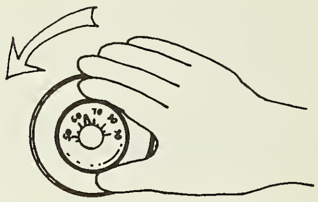
If you live in the part of the country that's shaded, here are two packages of energy-saving measures for you:

Package 1 is cheap and easy, and it pays for itself every year.

Package 2 saves even more, year after year. It can cut your heating bills by as much as one-half. It will pay for itself within 5 years.

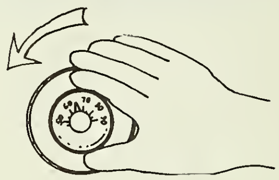
Package 1

1. **Turn down thermostat 6° in winter from your usual setting.**

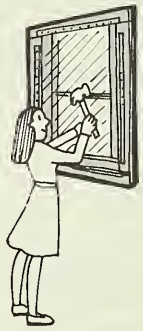


Package 2

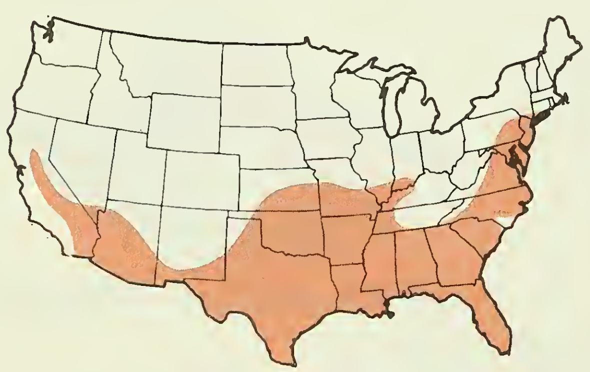
1. **Turn down thermostat 6° in winter from your usual setting.**



2. **Put on plastic storm windows.**



YOUR AIR-CONDITIONING SAVINGS

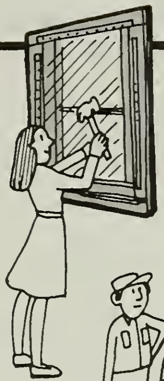


Package 3

Look at the map to the left.

Package 3 can save you money on your air-conditioning bills, if you live in the part of the country that's shaded.

2. Put on plastic storm windows.



3. Service your oil furnace

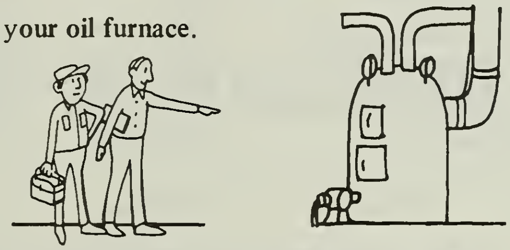
Here's an idea of what Package 1 costs and saves in a typical home.

	Yearly Cost	Yearly Savings
1. Turn down thermostat	$0	$27-87
2. Put on plastic storms	$7-9	$27-73
3. Service oil furnace	$25	$33-87
TOTAL	$32-34	$87-247

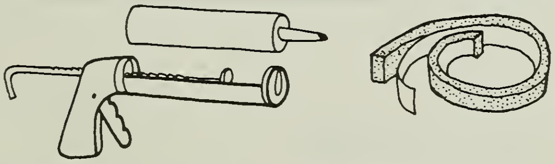
If you already have storm windows, or if you don't have an oil furnace – then take a look at package 2.

---

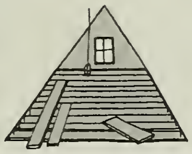
3. Service your oil furnace.



4. Caulk and weatherstrip your doors and windows.



5. Insulate your attic.



Here's an idea of what Package 2 costs and saves in a typical home (Items 4 and 5 reduce the heating bill to which the effects of Items 1, 2, and 3 are applied, so 1, 2, and 3 save less here than in Package 1):

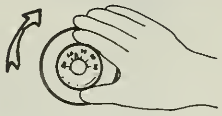
	1st Year Cost	Yearly Savings
1. Turn down thermostat	$0	$13-53
2. Put on plastic storms	$7-9	$20-60
3. Service oil furnace	$25	$20-53
4. Caulk and weatherstrip	$75-105*	$40-100
5. Insulate your attic	$300-450*	$50-75
TOTAL	$407-589	$143-341

* These are do-it-yourself costs. If you called a contractor, these items could cost twice as much.

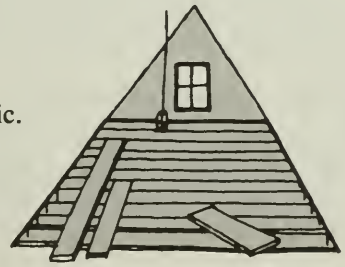
You might or might not need to do all of these things. Turn the page to find out which items apply to your home.

---

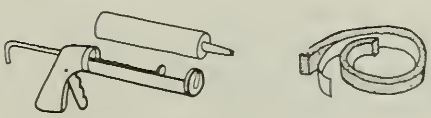
1. Turn up thermostat 6° in summer from your usual setting.



2. Insulate your attic.



3. Caulk and weatherstrip your doors and windows.



Here's an idea of what Package 3 costs and saves in a typical home:

	1st Year Cost	Yearly Savings
1. Turn up thermostat	$0	$7-20
2. Insulate your attic	$300-450*	$33-67
3. Caulk and weatherstrip	$75-105*	$27-67
TOTAL	$375-555	$67-154

* These are do-it-yourself costs. If you called a contractor, these items could cost twice as much.

You might or might not need to do all of these things. Turn the page to find out which items apply to your home.

And if you live in the part of the country that's shaded on both maps, these cooling savings are *in addition* to what you save on heating – turn the page to see what your total savings will be.

HEATING AND AIR-CONDITIONING SAVINGS TOGETHER

If you have whole-house air conditioning and if you live in the part of the country that's shaded on **both** of the maps on the previous page, some of the energy-saving steps save on **both** heating and cooling – but you only have to pay for them once.

LOOK AT THESE TWO TABLES FOR AN ESTIMATE OF THE COMBINED COSTS AND SAVINGS FOR A TYPICAL HOME:

Table 1

Package 1 plus turning up the thermostat in summer:

	Yearly Cost	Yearly Savings
Turn down thermostat in winter	$0	$27-87
Turn up thermostat in summer	$0	$7-20
Put on plastic storms	$7-9	$27-73
Service oil furnace	$25	$33-87
TOTAL	$32-34	$94-267

Table 2

Package 2 and **Package 3** together:

	1st Year Cost	Yearly Savings
Turn down thermostat in winter	$0	$27-87
Turn up thermostat in summer	$0	$7-20
Put on plastic storms	$7-9	$20-73
Service oil furnace	$25	$20-53
Caulk and weatherstrip	$75-105*	$67-167
Insulate attic	$300-450*	$80-227
TOTAL	$407-589	$221-626

* **These are do-it-yourself costs. If you have a contractor do it, these items could cost about twice as much.**

Which items do you need to do?

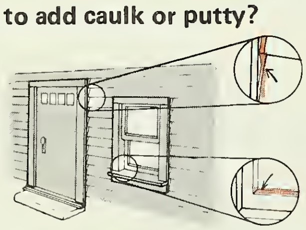
Do you need to adjust your thermostat?

Everyone can profit from turning their thermostat down in winter and up in summer.

Do you need to put on storm windows or service your oil furnace?

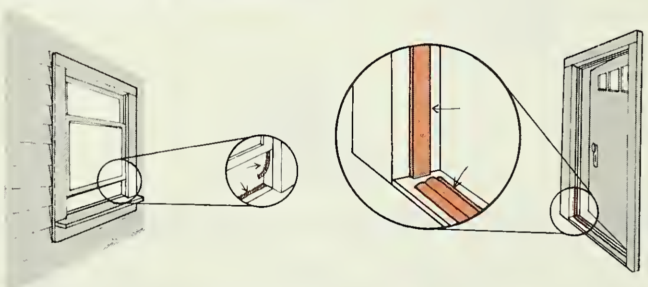
You do if you live in the part of the country that's shaded on the upper map on the last page. Put on storm windows if you don't have them already. Plastic ones are cheapest. See page 40. Service your oil furnace each year if you have one. See page 63. If you have a gas furnace, service it every three years and save, too.

Do you need to add caulk or putty?



Look around the edges of a typical window, where the picture shows. Check the edges of your doors, too. There should be some filler in all these cracks. That's either *caulking* or *putty*. If it's old, brittle, and broken up, or if it's missing altogether, you need to put some in. Go to page 34 to find out how to do it.

Do you need to weatherstrip?



Look for the strips of vinyl, metal, or foam rubber around the edges of your windows and doors. That's *weatherstripping*. If it's missing or deteriorated, you need to put some in. Go to pages 36-39 to find out how to do it.

Do you need to insulate your attic?

Go up into your attic and see how much insulation is there. Usually, there's a door or hatchway to the attic. If not, get a contractor to check it for you. Look at the table on page 44 to see how much more insulation you need.

> **Keep Going**
>
> . . . there are lots more energy-saving ideas in Parts 3 and 4, starting on page 33. If you want more accurate cost and savings figures, look at Part 2, starting on the next page.

PART 2: A CLOSER LOOK AT YOUR HOME

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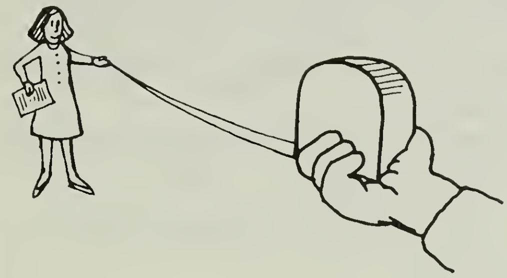
PART 2: A CLOSER LOOK AT YOUR HOME



This part of your manual takes a closer look at your home, where it is in the country, and the best, cheapest way to fix up your house to save energy. In Part 2 there are 12 valuable energy-saving steps. You'll find out which ones apply to your home and:

1. **How much they'll cost;** of those steps that do apply, which you can afford.
2. **Which to do first;** of those steps you can afford, which ones get you your money back the fastest.
3. **How much you'll save** by taking an energy-saving step.

You Can Skip Some of Part 2

Each energy-saving step has a page or two in this part. Go through these one at a time. You'll see immediately that you can skip some of them.

There's a section at the beginning of the pages on each energy-saving step. Reading this section and checking some items around your home, you'll find some more measures you can skip.

Some of Part 2 is Just What You Need

There are sure to be several energy-saving steps here that *do* apply to your home. Every time you find a step that does, follow the pages through until you get the two important numbers for each step: COST, and SAVINGS FACTOR, then copy them onto the Energy Checklist at the end of the book. The Energy Checklist lets you see all the numbers for your energy-saving steps in one place. Once you've copied your COST and SAVINGS FACTOR onto the Checklist, there's a little arithmetic – the directions are all right there. Then you're ready to go – you'll know what to do first, how much you'll save the first year, and whether you can afford it.

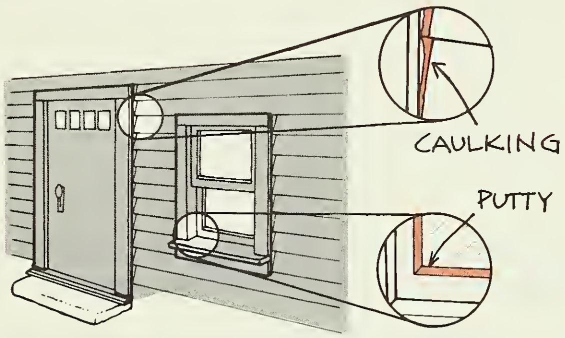
TABLE OF CONTENTS

CAULK AND WEATHERSTRIP YOUR DOORS AND WINDOWS

Caulking and weatherstripping are good cheap ways to save energy. It's worth your while to check to see if you need caulking, putty, or weatherstripping on your windows and doors.

DO THEY NEED CAULKING OR PUTTY?

Look at a typical window and a typical door. Look at the parts shown in the pictures. Check the box next to the description that best fits what you see:



☐ OK . . . All the cracks are completely filled with caulking. The putty around the window panes is solid and unbroken; no drafts.

☐ FAIR . . . The caulking and putty are old and cracked, or missing in places; minor drafts.

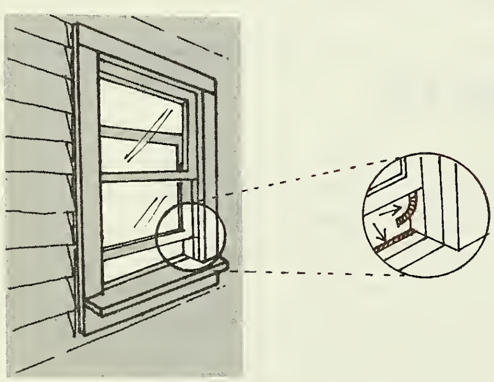
☐ POOR . . . There's no caulking at all. The putty is in poor condition; noticeable drafts.

If you checked either "FAIR" or "POOR", then you probably need caulking.

DO THEY NEED WEATHERSTRIPPING?

A. YOUR WINDOWS

Look at the parts shown in the pictures of one or two of your typical windows. Check one:



☐ OK . . . Good, unbroken weatherstripping in all the indicated places; no drafts.

☐ FAIR . . . Weatherstripping damaged or missing in places; minor drafts.

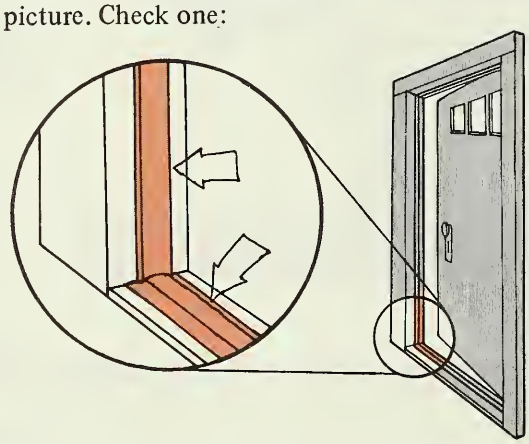
☐ POOR . . . No weatherstripping at all; noticeable drafts.

If you checked either "FAIR" or "POOR", then your windows probably need weatherstripping.

Be careful, they may be in such poor condition that weatherstripping can't be installed. See p. 36.

B. YOUR DOORS

Look at the parts of your doors shown in the picture. Check one:



☐ OK . . . Good, unbroken weatherstripping in all the indicated places; no drafts.

☐ FAIR . . . Weatherstripping damaged or missing in places; minor drafts.

☐ POOR . . . No weatherstripping at all; noticeable drafts.

If you checked either "FAIR" or "POOR", then your doors probably need weatherstripping.

IF YOU CHECKED "OK" FOR ALL ITEMS, THEN YOU DON'T NEED CAULKING, PUTTY, OR WEATHERSTRIPPING. GO ON TO PAGE 10

IF YOU CHECKED "FAIR" OR "POOR" FOR ANY ITEM, COMPLETE THE NEXT PAGE.

Find Your Cost

1. Multiply the number of windows that need *caulking and putty* times the cost per window: → ______ (number of windows) X $0.90 = [ ]
2. Multiply the number of windows that need *weather-stripping* times the cost per window: → ______ (number of windows) X $4.00 = [ ]
3. Multiply the number of doors that need *caulking* times the cost per door: → ______ (number of doors) X $0.85 = [ ]
4. Multiply the number of doors that need *weather-stripping* times the cost per door: → ______ (number of doors) X $6.75 = [ ] +
5. Add up these numbers to get the total: → TOTAL COST [$]

This cost is your estimated *do-it-yourself* cost. (It's easy to do yourself — look at page 34.) If you get a contractor to do it, your costs will be greater — at least 2 to 4 times as much. Prices vary from area to area and from job to job, so check with local contractors for an estimate (see page 66).

Find Your Savings Factor

Fill out only the lines that apply to your house:

A. YOUR WINDOWS

Multiply these two numbers

caulking and putty:

in FAIR condition: → ______ (number of windows) X 0.3 = [ ]

in POOR condition: → ______ (number of windows) X 1.0 = [ ]

weatherstripping:

in FAIR condition: → ______ (number of windows) X 1.0 = [ ]

in POOR condition: → ______ (number of windows) X 8.4 = [ ]

B. YOUR DOORS

Multiply these two numbers

caulking:

in FAIR condition: → ______ (number of doors) X 0.3 = [ ]

in POOR condition: → ______ (number of doors) X 0.9 = [ ]

weatherstripping:

in FAIR condition: → ______ (number of doors) X 2.0 = [ ]

in POOR condition: → ______ (number of doors) X 16.8 = [ ] +

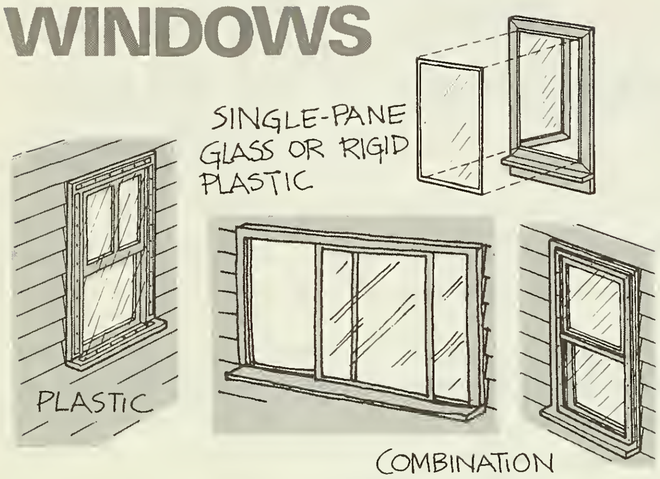
C. Add up all the numbers you've written in the boxes to the right and write the total here: This number is your savings factor. → SAVINGS FACTOR [ ]

GO TO THE ENERGY CHECKLIST AT THE END OF THE BOOK

Write the *total cost* you found above in the orange box on line 1 of the Checklist.

Write the *savings factor* you found above in the grey box on line 1 of the Checklist.

INSTALL STORM WINDOWS



There are five kinds of storm windows:

PLASTIC (POLYETHYLENE SHEET). These come in rolls and cost only 65¢ each. You may have to put up replacements each year.

SINGLE PANE GLASS OR RIGID PLASTIC. These cost $25.00 for glass and $8.00 for acrylic panes. You put them up and take them down each year.

TRIPLE–TRACK GLASS (COMBINATION). These have screens and you can open and close them. They are for double-hung or sliding windows (see the illustration). They cost about $33.00 each installed. They are available for less without screens.

All five kinds are about equally effective. The more expensive ones are more durable, attractive, and convenient.

FILL OUT ONE OR MORE OF LINES A, B, AND C – WHICHEVER ONES YOU'RE INTERESTED IN.

A. PUT ON PLASTIC STORM WINDOWS WITHOUT WEATHERSTRIPPING

Your cost: Count the number of windows you have and multiply times $0.65:

_______ X $0.65 = $ ______

number of windows — total cost

Your Savings: In step A on page 8 you checked either "OK," "fair," or "poor" as the condition of the weatherstripping on your windows.

– If you checked "OK", circle this number **7.9**
– If you checked "FAIR" circle this number **8.2**
– If you checked "POOR" circle this number **10.8**

Multiply the number you circled times the number of windows you have:

_______ X _______ = ______

number you circled — number of windows — savings factor

B. PUT ON PLASTIC STORM WINDOWS AT THE SAME TIME YOU WEATHERSTRIP (see Note)

Your cost: Multiply your number of windows times $0.65:

_______ X $0.65 = $ ______

number of windows — total cost

Your savings: Multiply your number of windows times 7.9 :

_______ X 7.9 = ______

number of windows — savings factor

C. PUT ON GLASS OR RIGID PLASTIC STORM WINDOWS (see Note)

Your Cost: Choose which kind of glass or rigid plastic storm windows you want, and multiply the number of windows you have times the cost given below:

Single-pane, rigid plastic	$ 8.00
Single-pane glass	$25.00
Triple-track glass (combination), double hung or slider	$33.00

_______ X $ _______ = $ ______

number of windows — total cost

Your savings: Multiply your number of windows times 7.9 :

_______ X 7.9 = ______

number of windows — savings factor

SEE THE ENERGY CHECKLIST AT THE END OF THE BOOK

NOTE: These cost and savings factors are for storm windows only. They are in addition to the costs and savings for caulking and weatherstripping that you found on the last page.

If you filled out Part A here, fill out line 2a of the Checklist.

If you filled out Part B here, fill out line 2b of the Checklist.

If you filled out Part C here, fill out line 2c of the Checklist.

In each case, write the total cost into the orange box on that line and the savings factor into the grey box.

INSULATING YOUR ATTIC

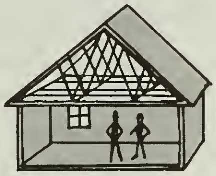
Attic insulation is one of the most important energy-saving home improvements you can make. This section talks about insulating 3 kinds of attics.

IF YOUR HOME HAS ONE OF THE 3 KINDS SHOWN BELOW,

go straight to the page in this section that applies, work it through, and fill out one of the lines in the attic portion of the Energy Checklist at the end of the book.

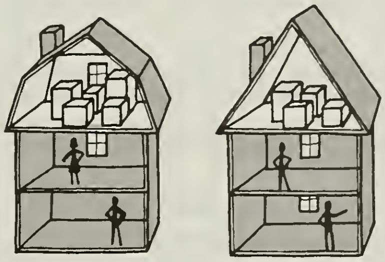
Unfinished Attics

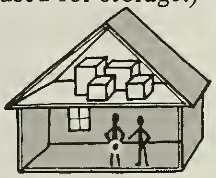
Unfinished Attic without a floor. Attic isn't used at all. (This includes Attics with roof trusses in them.)



Page 12

Unfinished Attic with a floor. (Attic can be used for storage.)





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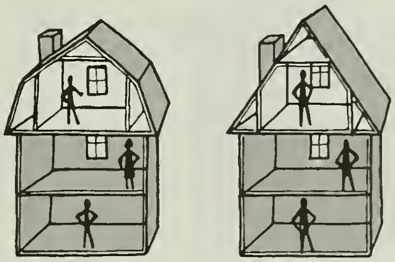
Finished Attics

Finished Attic that can be used for living or storage.



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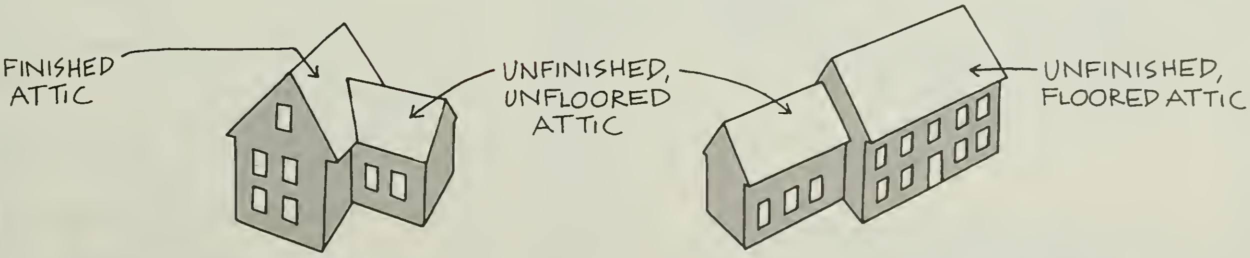
IF YOUR HOME IS A COMBINATION OF TWO KINDS OF ATTICS

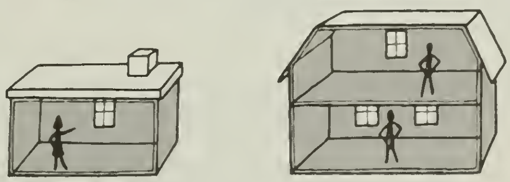
(part of your attic may be finished and heated, part may be unused except as storage, as in these sample houses):

If this is your situation, treat each of your attics separately. Go to both of the pages in this section that apply, and fill out both lines in the attic portion of the Energy Checklist at the end of the book.

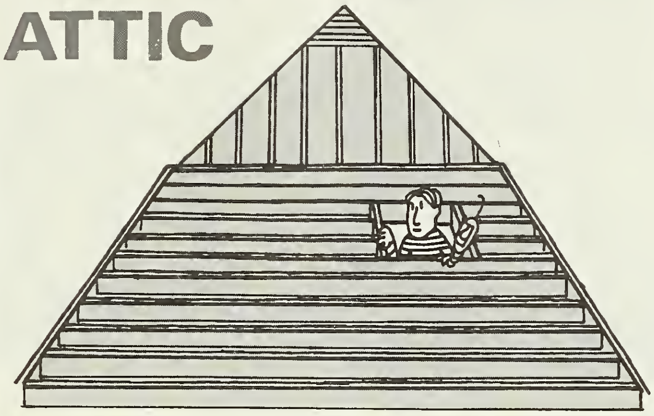


Flat roof? Mansard roof?

If your home has a flat roof, or a mansard roof, it will be harder and more expensive to insulate than the others – talk to a contractor – see Part 3 on how to pick a contractor.



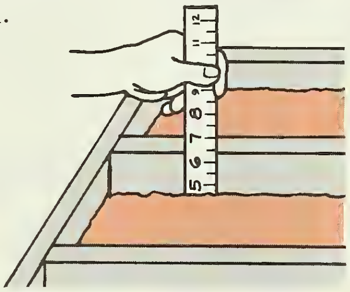
INSULATE YOUR UNFINISHED ATTIC



This is the kind of attic you have if it has no floor – at most some loose boards to walk on, and you don't ever plan to finish it.

Should you insulate it ?

It depends on how much insulation is already there. To find out, go up into your attic and measure the depth of the insulation.



No

If you already have 8" or more, you may have enough, and you can skip the rest of this page. Check the table on page 44 to be sure.

Yes

If you have less than 9", you may need more, and you should keep going on this page. Start by writing down the approximate thickness you have:

__________ inches

You'll need this number in a minute.

Go on to the next column.

NOTE: If you can't get up into your attic to measure the depth of your insulation, you will need a contractor to do the work. Call him for a cost estimate. Ask the contractor to tell you how much insulation is already there. Then ask him for an estimate to add the R-value recommended on these pages.

LESS THAN NINE INCHES?

Go through the steps marked 1, 2 and 3, on this and the next page. Then read the directions in the lower right-hand corner of the next page to interpret the chart.

1. How much should you add?

Given below are recommended amounts of insulation to add. For electrically heated homes, or extremely cold climates, these may still not be enough. For more precise advice on how much to add, see the table on page 44. If the table on page 44 recommends a greater thickness for your home than is given below, you can still use the tables on these pages to estimate insulation costs, but not fuel savings.

2. Should you do-it-yourself or hire a contractor?

You can do-it-yourself if there's a way for you to get up into the attic. If you aren't sure whether you want to do-it-yourself, look at page 47 to help you decide. Then, check "Do-it-yourself" or "Contractor" in one of the boxes below.

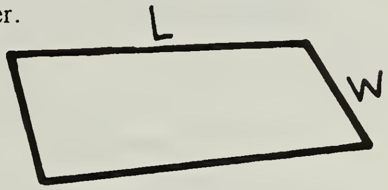
IF YOU HAVE THIS MUCH INSULATION		YOU NEED THIS MUCH MORE INSULATION *
NONE AT ALL		
	Do-it-yourself ☐	R-38(10"-18")
	Hire a contractor ☐	R-38(10"-18")
UNDER 2 INCHES		
	Do-it-yourself ☐	R-22(6"-10")
	Hire a contractor ☐	R-22(6"-10")
2 TO 4 INCHES		
	Do-it-yourself ☐	R-11(3"-5")
	Hire a contractor ☐	R-11(3"-5")
4 TO 6 INCHES		
	Do-it-yourself ☐	R-11(3"-5")
	Hire a contractor ☐	R-11(3"-5")
6 TO 8 INCHES		
	See page 44.	

3. How big is your attic?

To get your attic area, you don't even have to go up into the attic. Find out the area of the first floor of your home, not counting the garage, porch, and other unheated areas, and it will be the same as the area of your attic.

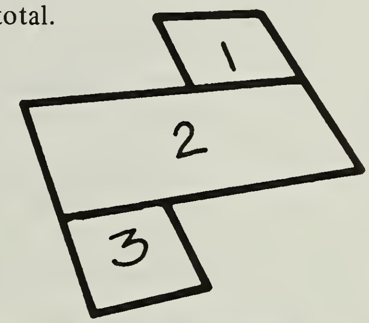
If it's a rectangle:

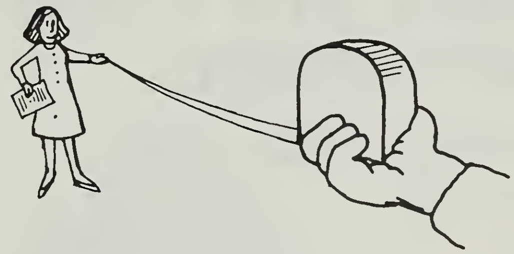
Measure its length and width in feet to the nearest foot and multiply them together.



If it's a combination:

Break it down into rectangles, find the area of each one, then add the areas to get the total.





length X width = area

_______ X _______ = _______

length X width = area

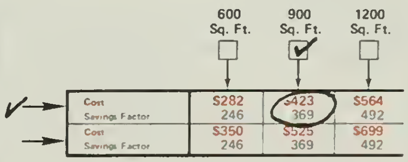
1 _______ X _______ = _______
2 _______ X _______ = _______
3 _______ X _______ = _______

total area _______

Check the number of square feet below that's closest to your total attic area

	600 Sq. Ft.	900 Sq. Ft.	1200 Sq. Ft.	1600 Sq. Ft.	2000 Sq. Ft.
Cost	$282	$423	$564	$752	$ 940
Savings Factor	246	369	492	656	820
Cost	$350	$525	$699	$932	$1166
Savings Factor	246	369	492	656	820
Cost	$168	$252	$336	$448	$ 560
Savings Factor	56	86	115	154	206
Cost	$198	$297	$396	$529	$ 661
Savings Factor	56	86	115	154	206
Cost	$ 78	$117	$156	$208	$ 260
Savings Factor	22	33	44	59	74
Cost	$ 86	$129	$172	$229	$ 286
Savings Factor	22	33	44	59	74
Cost	$ 78	$117	$156	$208	$ 260
Savings Factor	12	18	24	32	40
Cost	$ 86	$129	$172	$229	$ 286
Savings Factor	12	18	24	32	40

Read across and down the chart from the boxes you've checked to find which square in the chart applies to you, like this:



Copy these two numbers onto line 3 of the Energy Checklist at the end of the book. The orange number, your cost, goes in the orange box, the grey number, your savings factor, goes in the grey box.

*Different insulating materials require different thicknesses to achieve the same R-Value. See Page 46.

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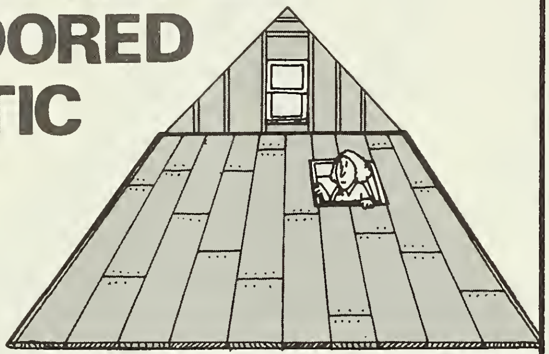
INSULATE YOUR UNFINISHED FLOORED ATTIC



This is your kind of attic if it's unfinished and unheated but has a floor.

Should you insulate it ?

It depends on how much insulation is already there. To find out, go up there and check.

The insulation, if there is any, will be in either of two places:

Between the rafters. The first place to look is up between the rafters and in the walls at the ends of the attic.

Under the floor. If it's not up between the rafters, it might be down under the floorboards. If so, it won't be easy to see. You'll have to look around the edges of the attic, or through any large cracks in the floor. A flashlight may be handy, and also a ruler or stick that you can poke through the cracks with. If there's any soft, fluffy material in there, that's insulation.

Wherever the insulation is, if it's there at all, estimate how thick it is.

No

If it's thicker than 4 inches, it's not economical to add more – skip the rest of this page.

Yes

If it's 4 inches thick or less, you might need more – fill out these two pages to help you decide.

NOTE: **If you can't tell whether you have enough insulation up there, get a contractor to find out for you. You're likely to be calling one anyway to do the work, and you'll want a cost estimate from him. Ask the contractor to tell you how much insulation is already there, and use the figures he gives you to complete this page and fill out the Energy Checklist.**

Your cost and savings

To get a quick estimate of your costs and savings, follow steps 1 and 2 below and on the next page.

1. Which method ?

There are two basic ways to insulate this type of attic.

a. Insulate the rafters, end walls, and collar beams.

   This is the best way if you're doing it yourself, or if you think you might ever finish the attic.

b. The other way is to blow loose insulation in under the attic floor. This is a contractor job – you can't do it yourself. Also, don't do this if you think you might ever finish the attic. But if you're going to call a contractor, this is the cheapest and most effective way.

   To see what's involved in a do-it-yourself job of insulating the rafters, end walls, and collar beams, look at page 51. What's involved when a contractor does the work is on page 50.

There are three different methods listed below. Pick the one that you think you might want to do. For the method you've chosen, check one of the three boxes – the *top* one if there's no existing insulation, the *middle* one if there's up to 2 inches of existing insulation, or the *bottom* one if there's from 2 to 4 inches of existing insulation.

Then go to step 2 on the next page.

DO-IT-YOURSELF: RAFTERS, END WALLS, COLLAR BEAMS

No existing insulation ☐

0-2 inches ☐

2-4 inches ☐

CONTRACTOR INSTALLATION: RAFTERS, END WALLS, COLLAR BEAMS

No existing insulation ☐

0-2 inches ☐

2-4 inches ☐

CONTRACTOR INSTALLATION: UNDER ATTIC FLOOR

No existing insulation ☐

0-2 inches ☐

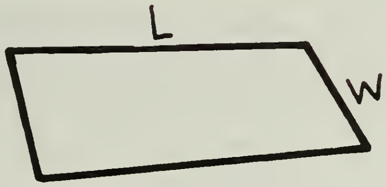
2-4 inches ☐

2. How big is your attic ?

Your unfinished, floored attic area will be either shaped like a rectangle or a combination of rectangles.

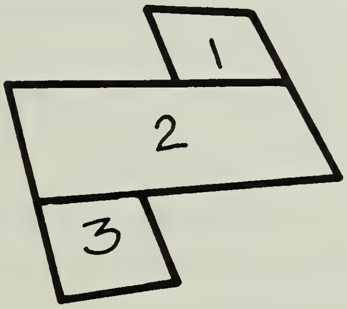
If it's a rectangle:

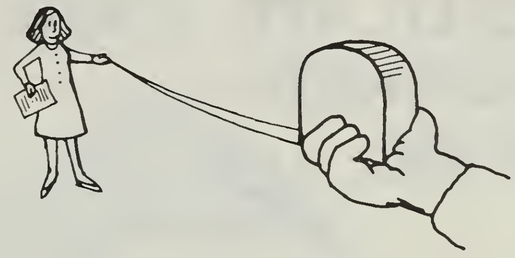
Measure it's length and width in feet to the nearest foot and multiply them together.



If it's a combination:

Break it down into rectangles, find the area of each one, then add the areas to get the total.





length X width = area

______ X ______ = ______

length X width = area

1 ______ X ______ = ______

2 ______ X ______ = ______

3 ______ X ______ = ______

total area ______

Check the number of square feet below that's closest to your attic floor area:

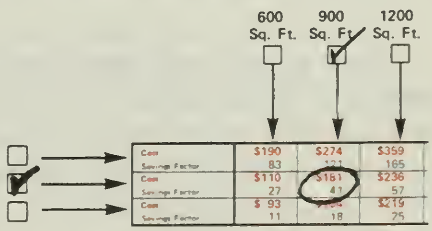
	600 Sq. Ft. ☐	900 Sq. Ft. ☐	1200 Sq. Ft. ☐	1600 Sq. Ft. ☐	2000 Sq. Ft. ☐
Cost	$190	$274	$359	$487	$ 595
Savings Factor	83	121	165	224	284
Cost	$110	$181	$236	$366	$ 444
Savings Factor	27	41	57	74	92
Cost	$ 93	$164	$219	$310	$ 388
Savings Factor	11	18	25	34	43

Cost	$346	$500	$657	$885	$1082
Savings Factor	83	121	165	224	284
Cost	$187	$314	$409	$644	$ 781
Savings Factor	27	41	55	72	88
Cost	$158	$285	$380	$549	$ 686
Savings Factor	9	15	22	30	38

Cost	$296	$445	$593	$790	$ 988
Savings Factor	170	256	341	454	568
Cost	$246	$369	$492	$656	$ 820
Savings Factor	49	73	97	130	162
Cost	$210	$315	$420	$560	$ 700
Savings Factor	18	27	36	48	60

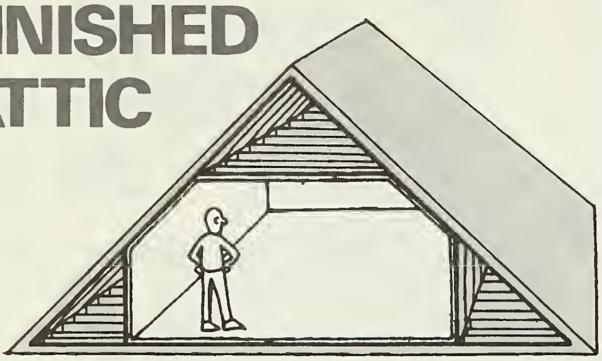
How to read the chart

Read down and across from the boxes you've checked to find which square in the chart applies to you, like this:



Copy these two numbers onto line 3 of the Energy Checklist at the back of the book. The orange number, your cost, goes in the orange box, the grey number, your savings factor, goes in the grey box.

INSULATE YOUR FINISHED ATTIC



This attic is a little harder to insulate than an unfinished attic because some parts are hard to reach. A contractor can do a complete job, but if you do-it-yourself, there will probably be parts that you can't reach.

Should you insulate it?

You need to find out if there's enough insulation there already.

Depending on what your house is like, you may or may not be able to measure your insulation by getting into the unfinished spaces in your attic through a door or hatchway.

1. **IF YOU CAN GET IN,** measure the depth of insulation. If you have 9 inches or more of insulation everywhere, you have enough and you can skip the rest of this page.

2. **IF YOU CAN'T GET INTO THE UNFINISHED PARTS OF YOUR ATTIC AT ALL,** have a contractor measure the insulation for you. Ask him how much is there, and use these figures to complete page 17 and fill out the Energy Checklist.

When you go to take a look at these places, make a note of the depth of insulation that's already there; you'll want this information in a minute.

1. Which method?

You may have already found out that you can't do-it-yourself because you can't get into the unfinished part of your attic. If you can get in, there are some good things you can do yourself to insulate it.

Depending on your particular attic you may be able to do one or more of these:

A. INSULATE ATTIC CEILING

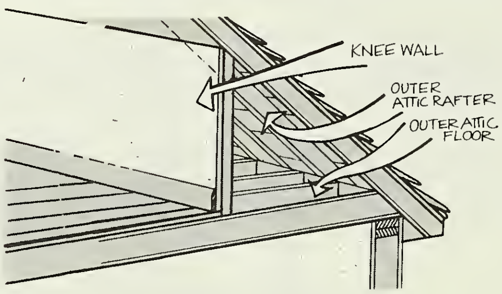
You can insulate your attic ceiling if there's a door to the space above the finished area. You should consider insulating it if there's less than 9 inches already there.

B. INSULATE OUTER ATTIC RAFTERS

"Outer attic rafters" are the parts of the roof shown in the picture below:

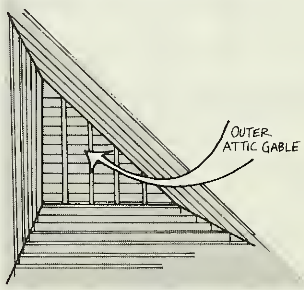
You should consider insulating them if:

- there's no insulation between the rafters; and
- there's room for more insulation in the outer attic floor and in the "knee walls" that separate the finished and unfinished parts of the attic.



C. INSULATE OUTER ATTIC GABLES

"Outer attic gables" are the little triangular walls shown in the picture. You should insulate them if you insulate the outer attic rafters.



To get a better idea of what's involved in doing-it-yourself, read page 53. See page 44 to see how thick the insulation should be.

If you want to find costs and savings for a do-it-yourself insulation job, use the next page.

If you want to estimate costs and savings for contractor installation, go on to page 18.

Costs and savings for do-it-yourself insulation

1. How big are the areas you want to insulate?

Multiply the length times the width (in feet) of each area that you can insulate.

a. ATTIC CEILING

length X width = area

_____ X _____ = ________

b. OUTER ATTIC RAFTERS (there may be several areas you'll need to add together here)

length X width = area

_____ X _____ = ______

_____ X _____ = ______

_____ X _____ = ______

+

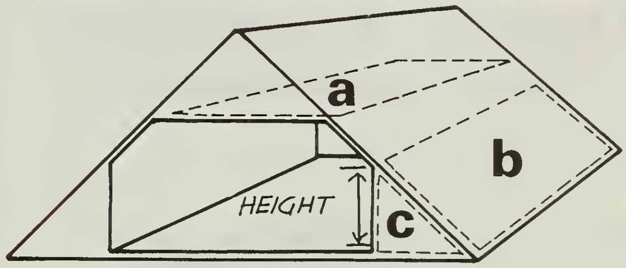
TOTAL [ ]

c. OUTER ATTIC GABLES (the area of these triangles is only half the length times the height.)

length X height ÷2 = area

_____ X _____ ÷2 = _____

Multiply by the number of gable ends to get the total area.



2. Your Savings Factor

For each part of your attic that you've measured, check below about how much insulation is already there. For each row you've checked, multiply your area times the number written to the right:

ATTIC CEILING

☐ none _______ X .38 = ________

☐ 0-2 inches _______ X .09 = ________

☐ 2-4 inches _______ X .04 = ________
area

OUTER ATTIC RAFTERS (existing insulation will be in the floor and knee walls)

☐ none _______ X .23 = ________

☐ 0-2 inches _______ X .09 = ________

☐ 2-4 inches _______ X .05 = ________
area

OUTER ATTIC GABLES (existing insulation will be in the floor and knee walls)

☐ none _______ X .16 = ________

☐ 0-2 inches _______ X .06 = ________

☐ 2-4 inches _______ X .03 = ________
area

+

TOTAL [ ]

Add the results from each row you've filled out to get your Savings Factor.

3. Your Cost

ATTIC CEILING:

If there's no existing insulation:

______ X $0.37 = ______
area

If there's up to 2 inches of existing insulation:

______ X $0.24 = ______
area

If there's 2 to 4 inches of existing insulation:

______ X $0.13 = ______
area

OUTER ATTIC RAFTERS:

If there's up to 2 inches of existing insulation:

______ X $0.24 = ______
area

If there's from 2 to 4 inches of existing insulation:

______ X $0.13 = ______
area

OUTER ATTIC GABLES:

______ X $0.13 = ______
area

GO TO THE ENERGY CHECKLIST

at the end of the book. On line 3, "Insulate Your Attic", write your total cost in the orange box and your savings factor in the grey box.

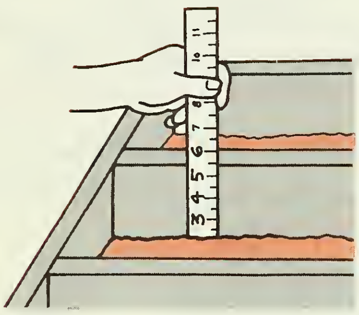
Costs and savings for contractor installation

Finished attics differ a lot in how much they cost for a contractor to insulate them. Therefore, this page gives you only a rough estimate of how much it would cost you. If you want a better figure, get a contractor to give you an estimate. To see what's involved, see page 53. To see how much insulation should be installed, see page 44.

Your cost and savings

To get a quick estimate of your cost and savings, follow steps 1, 2, and 3 on this page.

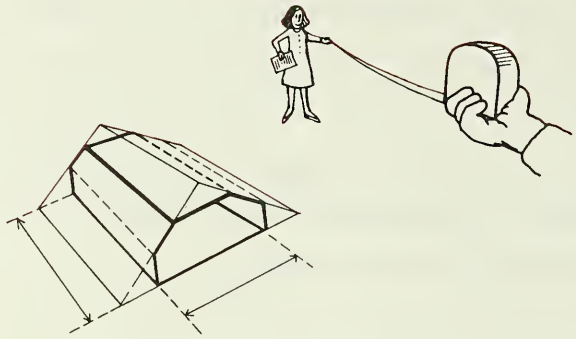
1. How much insulation do you have already?



Go up and measure the depth of existing insulation, if you haven't already.

Check the box below that's closest to the depth you find. Usually, there's the same thickness in all parts of the attic. If there are different thicknesses, figure the average depth and check it below:

2. How big is your attic?



Measure the length and width of the *finished part* of your attic. Round them off to the nearest foot and multiply them together:

length X width = area

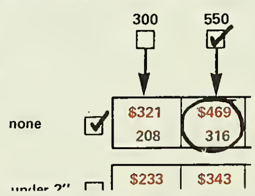
____ X ____ = _____

Check the number of square feet below that's closest to your finished attic area.

	300 ☐	550 ☐	800 ☐	1100 ☐	1400 ☐
none ☐	$321 208	$469 316	$587 429	$641 572	$745 721
under 2" ☐	$233 68	$343 97	$418 126	$469 167	$555 205
2"–4" ☐	$130 31	$214 44	$285 56	$322 74	$410 90

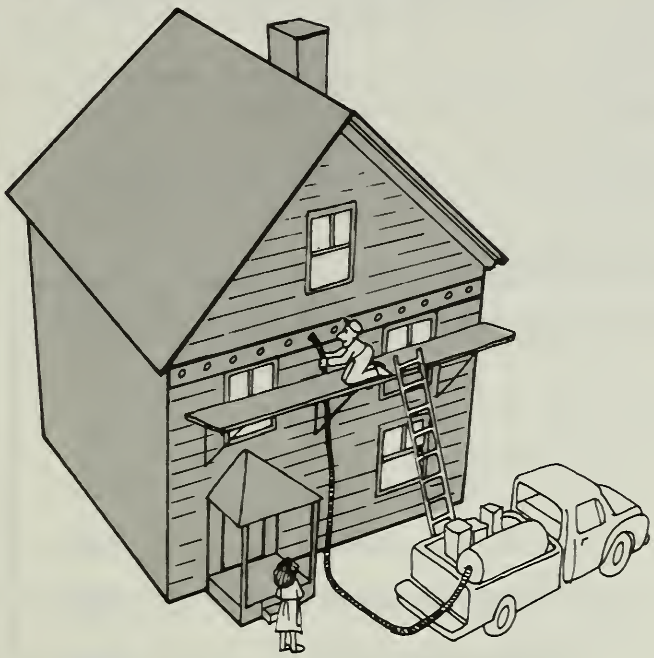
How to read the chart

Read down and across from the boxes you've checked to find which square in the chart applies to you, like this:



Copy the orange number into the orange box on line 3 of the Energy Checklist, "Insulate Your Attic", at the end of the book. Copy the grey number into the grey box on the same line.

INSULATE YOUR WALLS



Should you insulate them?

It depends on two things: the size of your energy bills and what your walls are like. To find out if you should insulate them, answer these two questions:

1. How big are your energy bills?

If you have just heating – NO whole-house air conditioning, look up the Heating Factor for your city on page 28 or 29. The Heating Factor is a number that reflects the climate in your area, and how much you pay for fuel. Look at the Heating Factor for the type of heating you have – gas, oil, electricity, or coal. It's one of the numbers in the first four columns.

If your Heating Factor is **0.37** or more, keep on going. If it's less than **0.37,** skip these two pages.

If you have heating AND whole-house air conditioning, look up both your Heating Factor and your Cooling Factor. They're listed on page 28 or 29. Look up the Heating Factor for your city for the type of heating you have – gas, oil, electricity, or coal. It's one of the numbers in the first four columns.

Then look up your Cooling Factor. It's the number in the fifth column.

Add together your Heating and Cooling Factors. If the sum is **0.37** or more, keep going. If it's less than **0.37,** skip these two pages.

2. What are your walls like?

Most houses have *frame* walls. They have a wood structure – usually 2 by 4's – even though they may have brick or stone on the outside.

Some houses have brick or block *masonry* walls that form the structure of the house, without a wooden backup.

If you have frame walls, you should consider insulating them if there's no insulation at all in them already. A contractor can fill them with insulation and cut energy waste through them by 2/3.

You may already know whether or not your walls have insulation in them. If you don't know, here's how to find out: Take the cover off a light switch on an outside wall. *(Turn off the power first.)* Shine a flashlight into the space between the switchbox and the wall material and see if you can see any insulation.

If there's *no* insulation there now, you may need more, so fill out these two pages.

If there *is* some there already, you don't need more, so skip the rest of these pages.

If you have masonry walls, it may be worthwhile to insulate them if they're uninsulated now, even though it's more complicated than insulating frame walls; call a contractor to find out what's involved.

Condensation in Walls

None of the insulating materials contractors blow into frame walls serves as a barrier to moisture vapor; condensation in insulated walls may be a problem:

Look at the map on page 54. If you live in Zone I, and plan to insulate your walls, you need to take steps to ensure that too much moisture from the air in your house won't get into your walls. (In Zone II the problem is much smaller.) If it does, it is likely to condense there in the winter, and you will run two risks: first, that your insulation will become wet and won't insulate; and second, that enough moisture will collect to cause rot in the structure. Here's how to help avoid these dangers:

1. Seal any opening in the inside walls that could afford a path to moisture, especially around the window and door frames.

2. Paint interior walls with a low-permeability paint; this can be a high-gloss enamel or other finish – ask your paint dealer.

TURN TO THE NEXT PAGE FOR YOUR COST AND SAVINGS FACTORS

COSTS AND SAVINGS FOR WALL INSULATION

1. What kind of insulation?

Some kinds of wall insulation cost more than others, and some kinds work better than others. Generally, you get what you pay for – if you spend more, you get better insulation.

The least expensive is *mineral fiber* insulation. There are two kinds; rock wool and glass fiber. Either kind can be blown into the wall by means of a special machine.

A slightly more expensive but more effective insulation is *cellulosic fiber*. This is another loose insulation that's blown in like mineral fiber.

The most expensive and perhaps the most effective insulation is ureaformaldehyde-based foam (*not* urethane foam – urethane foam is not good in walls). Quality control problems with ureaformaldehyde-based foam require that you choose a qualified installer.

2. How big is your house?

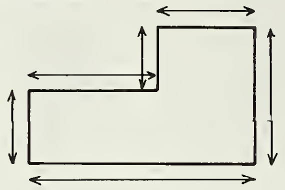
Measure the *perimeter* – the total distance around the outside – of each story of your house that has frame walls.

Measure around the heated parts only. Measure in feet to the nearest ten feet.

Write the perimeters for each story over here: →

If you have a finished, heated attic, measure the widths of the end walls of the attic *only*. Add up the width of all these walls and write the total to the right: →

Add up all the numbers you've written and write the total number of feet of walls here: →



First story perimeter ________ feet

Second story perimeter ________ feet

Third story perimeter ________ feet

Finished attic end walls + ________ feet

TOTAL [   ] feet

Check the number of feet at the right that's closest to the number of feet of the walls you found above.

		LINEAR FEET OF WALLS 100 L.F. ☐	150 L.F. ☐	200 L.F. ☐	250 L.F. ☐	300 L.F. ☐	400 L.F. ☐
Mineral Fiber	Cost	$397	$596	$ 794	$ 993	$1191	$1588
	Savings Factor	100	155	205	255	310	410
Cellulosic Fiber	Cost	$447	$671	$ 894	$1118	$1341	$1788
	Savings Factor	110	170	225	280	335	450
Ureaformaldehyde-Based Foam	Cost	$596	$894	$1192	$1490	$1788	$2384
	Savings Factor	115	175	230	290	350	460

How to read the chart

The chart shows the cost and savings factors for different kinds of insulation applied to different sizes of houses.

To use the chart, look at the column under the box you've checked.

		100 LF. ☐	150 LF. ☑	200 LF. ☐	250 LF. ☐
Mineral Fiber	Cost	$397	$596	$ 794	$ 993
	Savings Factor	100	155	205	255
Cellulosic Fiber	Cost	$447	$671	$ 894	$1118
	Savings Factor	110	170	225	280

Look at the orange numbers in that column – the estimated costs for installing each type of material. See which you can afford; remember that if the cost is higher, your savings will also be higher.

When you've figured out which cost you're willing to pay, copy that cost into the orange box on line 5 of the Energy Checklist at the end of the book, and the savings factor into the grey box on the same line.

INSULATING YOUR CRAWL SPACE WALLS, FLOOR, OR BASEMENT WALLS

If you live in a climate where your heating bill is big enough to be a worry, it's a good idea to insulate the underside of your house. It won't save much on air conditioning, but it will save on heating.

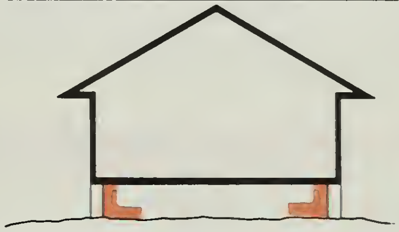
The underside of your house looks like one of these. Choose which of these pictures and descriptions looks like your house, and go to the page indicated.

A. A flat concrete slab sitting on the ground:

There's not much that you can easily do to insulate this type of foundation, and since it's hard to tell how much insulation is already there, it's hard to tell what your savings would be. Therefore, no cost and savings figures are given here for slab insulation. Go on to the next section on page 25.

B. A crawl space with walls around it:

If you have a crawl space that you can seal tightly in winter, you can insulate its walls and the ground around its outer edges. See page 22.

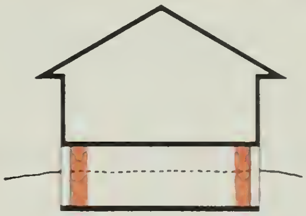


C. A floor over a garage, porch or open crawl space:

If there's an open space under your floor that you can't seal off tightly from the outside air, the place to insulate is in the floor, between the joists. See page 23.

D. Walls of a heated basement that stick out of the ground:

If you have a basement that is heated and used as a living area, it may be worth your while to insulate the basement walls down to a depth of two feet below the ground. See page 24.

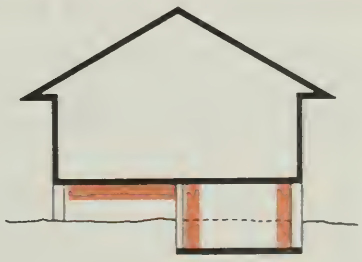


E. A combination of the above types:

Your house may be part heated basement and part crawl space, or some other combination. To estimate your costs and savings, treat each of the parts separately and go to the pages dealing with each part. There are three separate lines on the Energy Checklist:

- Insulate Crawl Space Walls
- Insulate Floor
- Insulate Basement Walls

You can fill out as many of these as apply to you, and see which are most important for you to do.



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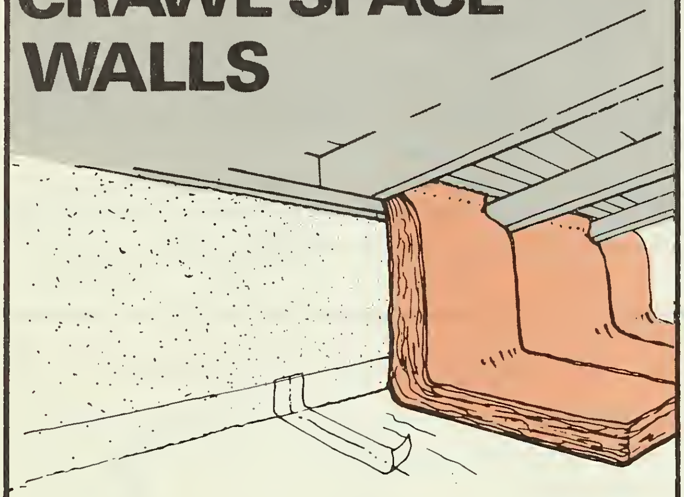
INSULATE YOUR CRAWL SPACE WALLS



If your house (or part of it) sits on top of a crawl space that can be tightly sealed off from the outside air in the winter the cheapest and best place to insulate it is around the outside walls and on the adjacent ground inside the space:

Should you insulate it?

Answer these two questions:

1. Is there *no* insulation at all around the crawl space walls or under the floor?
2. Is your crawl space high enough to get in there to do the work?

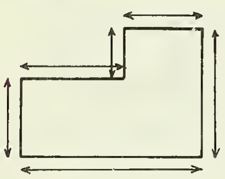
If the answer to either of these questions is "No" don't insulate here. Skip the rest of this page. If your answer to both questions is "Yes", fill out this page.

Your cost and savings

To get a quick estimate of your cost and savings, follow steps 1, 2, and 3 on this page.

1. Measure your crawl space

Measure the distance around the outside of the heated part of your crawl space (don't include areas underneath porches, and other unheated areas).



Write that distance down here, in feet (you'll need it in a minute):

_________feet

2. How much will it cost?

It makes a difference whether you want to do the work yourself or call a contractor. Doing it yourself is hard work, but you'll save a lot of money once you're through. If you're not sure which route you want to take – do-it-yourself or contractor – turn to page 56 to see what doing-it-yourself involves.

TO ESTIMATE THE COST IF YOU'RE DOING-IT-YOURSELF:

Multiply the total distance around your crawl space (the number you wrote in at the bottom of the last column) times $0.80, the cost per running foot:

_______	FEET (fill in)
X $ 0.80	PER RUNNING FOOT
$	DO-IT-YOURSELF COST

TO ESTIMATE THE COST IF A CONTRACTOR'S DOING THE WORK:

Multiply the distance around your crawl space that you wrote in at the bottom of the last column by $1.10, the cost per running foot.

_______	FEET (fill in)
X $ 1.10	PER RUNNING FOOT.
$	CONTRACTOR COST

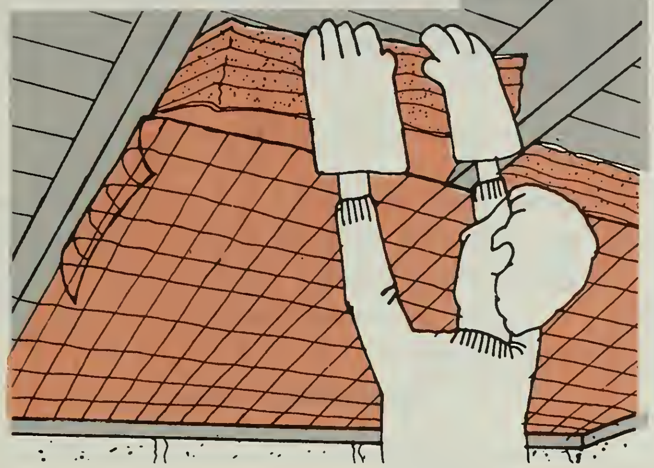
3. How much will you save?

To get your savings factor, multiply the distance around your crawl space times .54:

_______	FEET (fill in)
X 0.54	RUNNING FOOT SAVINGS
	SAVINGS FACTOR

Turn to the Energy Checklist at the end of the book. Go to line 4a, called "Insulate Crawl Space Walls". Write your cost in the orange box on that line, and write your savings factor in the grey box next to it.

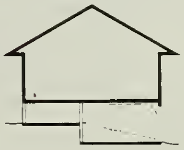
INSULATE YOUR FLOOR



There are two cases where it's good to insulate your floor:

1. You have a crawl space that you can't seal off in winter – for example, your house stands on piers:

2. You have a garage, porch, or other cold unheated space with heated rooms above it:



Should you insulate it?

1. Is your floor uninsulated?
2. Is the floor accessible?
   – If it's above a crawl space, is the crawl space high enough for a person to work in it?

No

If your answer to any of these questions is "No" don't insulate the floor. Skip the rest of this page.

Yes

If your answer to both questions is "Yes", fill out this page.

Your cost and savings

To get a quick estimate of your cost and savings, follow steps 1, 2, and 3 on this page.

1. Which method?

Decide whether you want to do it yourself or call a contractor. Look at page 58 to help you decide.

2. How big is your floor?

Measure the area of the floor that you plan to insulate.

If It's a Rectangle:
Measure the length and width of the floor in feet and multiply them together.

length	X	width	= area
________	X	________	= ________

If It's a Combination of Rectangles:
Break it down into rectangles. For each rectangle, measure its length and its width and multiply them together. Add these numbers to get the total area.

	length	X	width	=	area
1	_____	X	______	=	________
2	_____	X	______	=	________
3	_____	X	______	=	________

total area ☐

3. How to read the chart

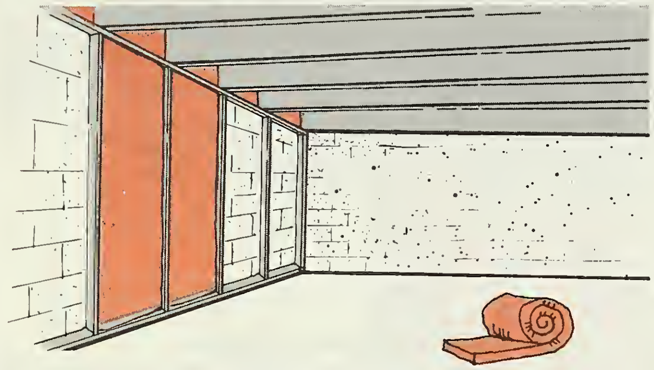
Check the number of square feet below that's closest to the floor area to be insulated that you found above.

Choose either the "do-it-yourself" or "contractor" column in the chart (see 1 above). Read down that column until you come to the row next to the number of square feet you've checked. Circle that box.

SQUARE FEET	Do-it-Yourself	Contractor	
200	$ 24 58	$ 56 58	Cost Savings Factor
400	$ 48 116	$112 116	Cost Savings Factor
600	$ 76 173	$167 173	Cost Savings Factor
900	$106 260	$250 260	Cost Savings Factor
1200	$152 347	$334 347	Cost Savings Factor
1600	$189 462	$445 462	Cost Savings Factor

Turn to the Energy Checklist at the end of the book. Go to line 4b, called "Insulate Floor". Write the orange number from the box you've circled into the orange box on that line, and the grey number into the grey box next to it.

INSULATE YOUR BASEMENT WALLS



If you have a basement that you use as a living or work space and that has air outlets, radiators, or baseboard units to heat it, you may find that it will pay to add a layer of insulation to the inside of the wall. The cost figures given below do not allow for the cost of refinishing as well as insulating.

Should you insulate them?

If your basement walls aren't insulated and if your basement's average height above ground is two feet or more, then it pays to insulate them in almost any climate if you do the work yourself. If your basement's average height above ground is less than two feet, then it pays to insulate these walls yourself if your Heating Factor is more than 0.7.

If you want to have a contractor do it, your Heating Factor should be 0.5 or more if your basement's average height above ground is two feet or more. If the height is less than two feet, you should not have the work done.

Your cost and savings

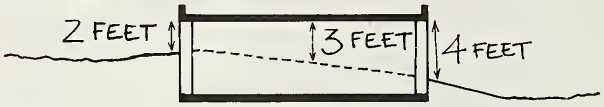
To get a quick estimate of your cost and savings, follow steps 1 and 2 on this page.

1. Make some measurements

Measure the length of each wall that sticks 2 or more feet above ground and add the lengths together.

Write the total number of feet here:_______ feet.
length of wall

Estimate to the nearest foot how far on the average these walls stick up above ground. For example, suppose your house is on a slope like this:



The average height above ground for this house is three feet. Write your average height above ground here:_____feet.

2. How to use the chart

At the top of the chart, check the height of your basement walls above ground that's closest to the amount you wrote above in Step 1.

At the side of the chart, check either "do-it-yourself" or "contractor".

Read across the row you checked until you come to the column you checked. Circle the square where the row and the column meet.

AVERAGE HEIGHT ABOVE THE GROUND

	0 Feet ☐	2 Feet ☐	4 Feet ☐	6 Feet ☐	8 Feet ☐	
Do-It-Yourself ☐	$1.84 0.2	$1.84 1.1	$1.84 2.0	$1.84 2.8	$1.84 3.4	Cost Savings Factor
Contractor ☐	$4.84 0.2	$4.84 1.1	$4.84 2.0	$4.84 2.8	$4.84 3.4	Cost Savings Factor

Multiply the top number in the square you circled times the total length of the walls that you wrote down in Step 1. The result is your estimated total cost.

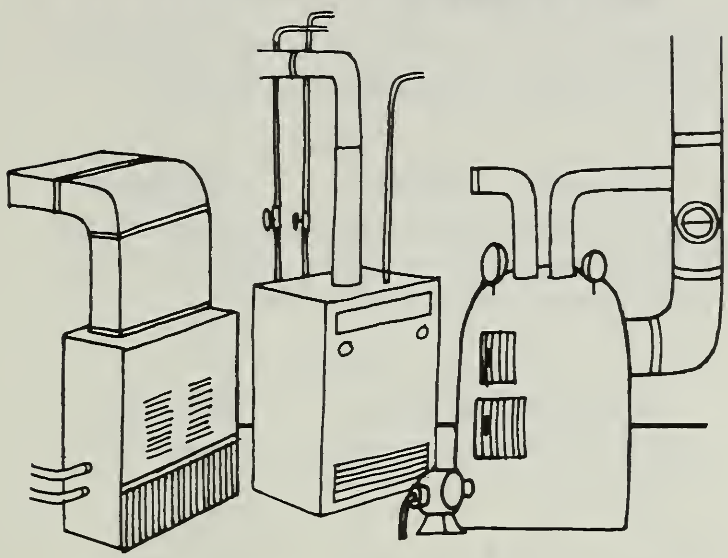
$_______ X _______ = $_________
top number   length of wall   Cost

Multiply the bottom number in the square that you circled times the total length of the walls to get your savings factor.

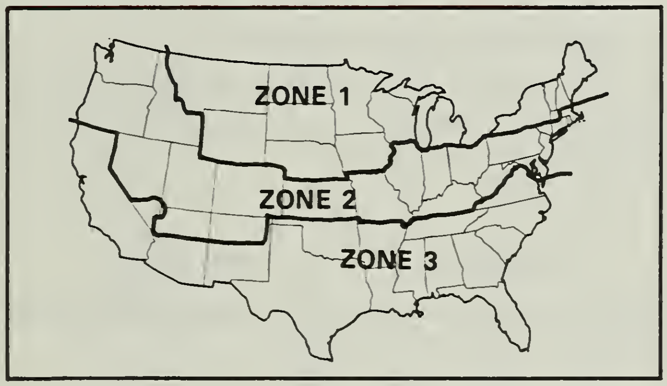
__________ X _______ = __________
bottom number   length of wall   savings factor

Turn to the Energy Checklist at the end of the book. Go to Line 4c, called "Insulate Basement Walls". Copy the total cost you've found into the orange box on that line and the savings factor into the grey box on the same line.

THERMOSTAT, FURNACE AND AIR CONDITIONER



YOUR THERMOSTAT



The table below tells you what percent of your heating bill you'll save by turning down your thermostat. Look at the map above to see which zone you live in. Read the column in the table for that zone. Circle either the top or bottom number in that column – you'll need it after you figure out your heating bill.

Circle the top number if you want to see what you'll save with a 5-degree turn-down from your usual setting.

Circle the bottom number if you want to see what you'll save with an 8-degree turn-down from your usual setting.

	ZONE 1	ZONE 2	ZONE 3
5^0 turn-down	14%	17%	25%
8^0 turn-down	19%	24%	35%

Table 1

If you have whole-house air conditioning, you can save about 3 per cent of your air conditioning bill for each degree you turn up your thermostat. Usually, about a 4 degree turn-up will still be comfortable; above that the air conditioning system will have trouble keeping the house cool during the hot part of the day. Figure out how many degrees you can turn up your thermostat, then multiply the number of degrees by 3 to get your percent savings:

____________	X 3 =	________
degree turn-up		%savings

YOUR HEATING BILL

The method for figuring out your heating bill depends on what kind of fuel you use. Pick the method below that applies to you:

NOTE: **You may heat with two fuels; for example, most of your house may be heated with oil or gas, while some newer rooms may have electric heat. In this case, do this section once for each fuel, and add the results together.**

A. Oil or coal heat

If you have an oil or coal furnace that heats your house but *not* your hot water, then all of your oil or coal bill goes to heating. Simply add up your fuel bills for last year. Write the total here:

$ ____________

If your furnace heats your hot water too, add up your fuel bills for last year and multiply the total by 8:

$________	X .8	$ ________
total fuel bill		your heating bill

B. Gas or electric heat

If you have gas heat

OR

If you have electric heat WITHOUT whole-house electric air conditioning:

1. Write your *January* electric or gas bill (whichever kind of heat you have) on line 1 at the top of the next page.
2. Find the city nearest you from the table on page 27 There's a month written beside the name of that city. Write your electric or gas bill for that month on line 2.
3. Subtract line 2 from line 1 and write the difference on line 3.
4. Write the number from column A of the table for the city nearest you on line 4.

5. Multiply line 3 by line 4; write the result on line 5. That number's your estimated heating bill.

If you have electric heat AND whole-house air conditioning:

Follow steps 1-5 above, except for one thing: in step 4, use the number from column B of the table (instead of column A) for your city, and write it on line 4.

	$ ________	Line 1
SUBTRACT —	$ ________	Line 2
	$ ________	Line 3
MULTIPLY ×	________	Line 4
YOUR HEAT BILL	$	Line 5

YOUR AIR CONDITIONING BILL

If you have whole-house air conditioning, estimate how much it's costing you each year — Use this method: Look up the city nearest you in the table on the next page. If there's an asterisk (*) after the name of the city, your air conditioning savings will be insignificant; skip steps 1-5. If there's no asterisk, keep on going.

1. Write your *July* electric bill on line 1 below.
2. Find the city nearest you from the table on the next page. There's a month written beside the name of that city. Write your electric bill for that month on line 2.
3. Subtract line 2 from line 1 and write the difference on line 3.
4. *If you have electric heat* as well as air conditioning, write the number from column D of the table for the city nearest you on line 4. *If you have gas, oil, or coal heat, write* the number from column C of the table for the city nearest you on line 4.
5. Multiply line 3 by line 4: write the result on line 5. That number's your estimated air conditioning bill.

	$ ________	Line 1
SUBTRACT —	$ ________	Line 2
	$ ________	Line 3
MULTIPLY ×	________	Line 4
YOUR AIR CONDITIONING BILL	$	Line 5

YOUR DOLLAR SAVINGS

NOW THAT YOU'VE FOUND YOUR HEATING AND AIR CONDITIONING BILLS, YOU'RE READY TO FIND OUT HOW MUCH YOU CAN SAVE EACH YEAR ON THESE MEASURES.

1. YOUR THERMOSTAT

Multiply your heating bill by the percent you circled in table 1 on the previous page and divide by 100:

$ ________ X ________ ÷ 100 = ________
heating bill % savings dollar savings

If you have whole-house air conditioning, multiply your air conditioning bill by the percent you figured on the previous page and divide by 100:

$ ________ X ________ ÷ 100 = $ ________
air cond. bill % savings dollar savings

Add up your thermostat savings for heating and air conditioning;

$ ________ + $ ________ = $ ________
heat savings air cond. savings total savings

Write your total savings into the grey box on line 6 of the Energy Checklist at the end of the book.

2. YOUR OIL OR COAL FURNACE

If you have an oil or coal furnace that hasn't been serviced recently, multiply your heating bill by .1 if you have the furnace serviced.

$ ________ X 0.1 = $ ________
heating bill dollar savings

Write the result in the grey box on line 7 of the Energy Checklist at the end of the book.*

3. YOUR GAS FURNACE

If you have a gas furnace that hasn't been serviced recently, you can save too — see page 63.

4. YOUR AIR CONDITIONER

If you have a central air conditioner that hasn't been serviced recently, multiply your air conditioning bill by 0.1 if you have the unit serviced.*

$ ________ X 0.1 = $ ________
air cond. bill dollar savings

Write the result in the grey box on line 8 of the Energy Checklist at the end of the book.

* **An estimate of cost has been entered for you on the Energy Checklist. For greater accuracy, use an estimate from your own heating or cooling specialist.**

Location	Month	A: Gas Electric Heat Alone	B: Electric Heat With Electric A/C	C: Electric A/C Alone	D: Electric A/C With Electric Heat
Alabama					
Montgomery	May	4.2	5.2	7.3	7.3
Alaska					
Anchorage	July	7.8	7.8	*	*
Arizona					
Flagstaff	July	6.4	6.6	*	*
Phoenix	April	4.4	5.1	5.1	6.3
Arkansas					
Little Rock	May	4.3	4.7	5.6	5.9
California					
Bishop	Sept.	5.2	7.5	3.5	5.1
Eureka	July	17.0	17.0	*	*
Los Angeles	Oct.	6.0	7.1	10.5	***
Bakersfield	April	4.8	5.3	4.9	8.0
San Francisco	Sept.	6.7	7.0	*	*
Colorado					
Alamosa	July	6.0	6.0	*	*
Denver	Sept.	6.2	6.3	3.5	*
Connecticut					
New Haven	Sept.	5.8	6.1	4.7	**
Delaware					
Dover	May	5.7	5.8	3.8	9.6
District of Columbia					
Washington	May	5.3	5.5	4.3	6.7
Florida					
Miami†	Feb.	†	†	9.6	9.6
Tallahassee	April	4.4	4.9	5.6	6.5
Georgia					
Atlanta	May	4.8	5.2	4.7	5.4
Savannah	April	4.6	5.1	5.3	6.5
Idaho					
Boise	Sept.	5.9	6.0	3.1	**
Illinois					
Chicago	Sept.	5.5	5.8	5.2	**
Springfield	May	5.4	5.5	3.6	**
Cairo	May	4.7	4.9	4.2	5.3
Indiana					
Indianapolis	Sept.	5.6	6.1	6.5	**
Iowa					
Des Moines	Sept.	5.1	5.4	11.8	**
Dubuque	Sept.	5.8	6.0	4.1	*
Kansas					
Wichita	May	4.9	5.0	3.5	5.8
Goodland	Sept.	5.7	5.8	3.4	9.8
Kentucky					
Lexington	May	5.6	5.6	4.0	11.4
Louisiana					
Baton Rouge	April	4.1	4.8	5.9	6.5
Shreveport	April	4.6	5.0	4.9	7.7
Maine					
Portland	July	5.7	5.7	*	*
Maryland					
Baltimore	May	5.5	5.6	3.9	9.0
Massachusetts					
Worcester	Sept.	6.2	6.4	4.4	*
Michigan					
Lansing	July	5.5	5.5	*	*
Minnesota					
Duluth	July	6.0	6.1	*	*
Minneapolis	May	6.2	6.3	2.8	*
Mississippi					
Jackson	April	4.9	5.3	5.0	7.7
Missouri					
St. Louis	May	4.8	4.8	3.4	5.9
Springfield	May	5.6	5.7	3.7	9.1
Montana					
Helena	July	5.8	6.0	*	*
Nebraska					
Omaha	Sept.	5.3	5.5	4.3	*
Scottsbluff	Sept.	6.1	6.2	3.1	*

Location	Month	A: Gas Or Electric Heat Alone	B: Electric Heat With Electric A/C	C: Electric A/C Alone	D: Electric A/C With Electric Heat
Nevada					
Elko	Sept.	6.8	6.8	2.2	*
Las Vegas	April	4.7	4.9	4.1	5.7
New Hampshire					
Concord	July	5.5	5.9	*	*
New Jersey					
Atlantic City	Sept.	5.4	5.7	5.1	8.2
New Mexico					
Raton	Sept.	6.3	6.5	3.7	*
Silver City	Sept.	4.7	5.3	5.7	5.9
New York					
New York City	Sept.	5.1	5.6	5.9	8.0
Rochester	Sept.	6.1	6.4	5.0	*
North Carolina					
Raleigh	May	4.9	5.2	5.3	6.9
Wilmington	May	4.3	4.8	7.0	5.9
North Dakota					
Bismarck	July	5.3	5.5	*	*
Ohio					
Youngstown	Sept.	6.1	4.8	5.2	*
Cincinnati	May	5.4	5.4	4.0	10.0
Oklahoma					
Oklahoma City	May	4.5	4.8	4.9	6.1
Oregon					
Salem	July	6.1	6.5	*	*
Medford	May	7.4	6.3	3.3	11.3
Pennsylvania					
Philadelphia	May	5.7	5.8	3.8	10.5
Pittsburgh	Sept.	5.9	6.2	5.4	*
Rhode Island					
Providence	Sept.	5.9	6.1	4.7	*
South Carolina					
Charleston	April	4.7	4.9	4.9	6.2
Greenville-Spartanburg	May	4.6	5.0	4.8	5.4
South Dakota					
Rapid City	Sept.	6.3	6.3	3.2	*
Tennessee					
Knoxville	May	5.1	5.3	4.7	6.5
Memphis	May	4.3	4.8	5.2	5.6
Texas					
Austin	April	4.1	4.5	5.5	7.0
Dallas	April	4.6	5.0	5.0	7.7
Houston	April	4.0	4.8	5.9	7.0
Lubbock	May	4.7	5.2	6.8	9.3
Utah					
Salt Lake City	Sept.	5.6	5.7	3.2	6.4
Milford	Sept.	5.5	5.7	2.7	*
Vermont					
Burlington	July	5.6	5.9	*	*
Virginia					
Richmond	May	5.1	5.4	5.2	8.0
Washington					
Olympia	July	6.8	7.0	*	*
Walla Walla	Sept.	5.3	5.6	3.3	8.0
West Virginia					
Charleston	May	5.7	5.7	4.2	9.6
Elkins	Sept.	6.5	5.2	4.0	*
Wisconsin					
Milwaukee	July	5.7	6.2	*	*
Wyoming					
Casper	Sept.	6.7	6.8	2.8	*

*Air conditioning savings not significant.
**Your air conditioning bill is about 1/10 of your electric heating bill.
***Your air conditioning bill is about 1/4 of your electric heating bill.
†Heating savings not significant.

YOUR HEATING AND COOLING FACTORS

You already have all the Savings Factors for the energy-saving home improvements you're considering. Combine them with your Heating Factor and (if you have whole-house air conditioning) your Cooling Factor, and you'll get dollar savings. There's *one* Heating Factor, and *one* Cooling Factor for your house, and they are based on where you live, and how much you pay for the fuel you use for heating (and cooling). The Table on this page and the next has your Heating and Cooling Factors in it. There are two ways to use the Table: a quick approximate way, and a slower but more accurate way that uses your own fuel bill to get your own Factors.

1. The quick way

Find the row on the chart below that's for the city nearest you. Look at the first four columns in that row (A,B,C,D). Circle the number for your fuel. It's your Heating Factor.

If you have whole-house air conditioning, also circle the number in column E of the same row. That's your Cooling Factor.

Important: Check the fuel prices given in columns F through I. They were collected in mid-1977 and were used to figure the Heating and Cooling Factors given in Columns A through E. Compare them with the price you pay for fuel (see "How Much Do You Really Pay for Fuel" below). If you find a significant difference, figure your Heating and Cooling Factors in " 2. Using Your Own Bill" below.

Instructions for using these Factors are on the Energy Checklist at the end of the book.

2. Using your own bill

You can calculate your Heating Factor (and your Cooling Factor, if you have whole-house air conditioning), using the figures from your own utility bills.

To figure your exact Heating Factor, find the Heating Multiplier for your city and your fuel (Columns J-M), and multiply it by the price you pay for heating fuel. Make sure you use the right units: gas– ¢/100 Cu.Ft., oil – ¢/gal., electricity – ¢/Kwh, coal – ¢/lb. (see "How Much Do You Really Pay for Fuel"):

________	X	________	=	________
your fuel price		**your Heating Multiplier**		**Heating Factor** Enter on the Energy Checklist

To figure out your exact Cooling Factor, find the Cooling Multiplier in Column N for your city, and multiply it by the price you pay for electricity in **cents** per kilowatt hour, (see "How Much Do You Really Pay for Fuel"):

________	X	________	=	________
electricity price (¢/Kwh)		**your Cooling Multiplier**		**Cooling Factor** Enter on the Energy Checklist

How Much Do You Really Pay for Fuel?

Your true cost for 100 cu. ft. of gas, a kilowatt of electricity, etc., is sometimes pretty well hidden in your bill. Call your utility company and ask them for the true cost (including all "fuel adjustment" factors and taxes) of the *last* unit of fuel that you buy every month. Use this cost to figure your Heating and Cooling Factor.

		Heating Factors				Cooling Factor	Fuel costs				Heating Multipliers				Cooling Multiplier
		Gas	Oil	Elec	Coal		Gas ¢/100 cu. ft.	Oil ¢/gal.	Elec ¢/Kwh	Coal ¢/lb.	Gas	Oil	Elec	Coal	
		A	B	C	D	E	F	G	H	I	J	K	L	M	N
ALABAMA	Montgomery	.13	.28	.34	–	.13	12.00	38.88	1.50	–	.0105	.0071	.2260	.0987	.0859
ALASKA	Anchorage	.33	.86	1.21	–	.00	12.00	53.82	2.03	–	.0275	.0160	.5956	–	.0001
ARIZONA	Flagstaff	.48	.61	.72	–	.01	20.71	37.78	1.43	–	.0233	.0162	.5040	–	.0056
	Phoenix	.07	.23	.23	–	.20	8.20	37.78	1.43	–	.0081	.0062	.1741	–	.1430
ARKANSAS	Little Rock	.12	.40	.45	–	.11	8.40	39.22	1.40	–	.0147	.0102	.3176	–	.0769
CALIFORNIA	Bishop	.29	–	.59	–	.67	17.69	–	1.69	–	.0163	–	.3515	–	.0414
	Eureka	.35	–	.84	–	.00	16.51	–	1.84	–	.0212	–	.4580	–	.0001
	Los Angeles	.09	–	.28	–	.06	12.17	–	1.69	–	.0078	–	.1682	–	.0367
	Bakersfield	.12	–	.39	–	.17	12.17	–	1.84	–	.0097	–	.2093	–	.0941
	San Francisco	.22	–	.55	–	.01	15.70	–	1.84	–	.0137	–	.2967	–	.0059
COLORADO	Alamosa	.28	.58	1.18	–	.01	10.15	38.16	1.96	–	.0278	.0153	.6010	–	.0023
	Denver	.19	.56	.71	–	.05	11.03	39.90	1.96	–	.0168	.0140	.3640	–	.0231

		Heating Factors				Cooling Factor	Fuel costs				Heating Multipliers				Cooling Multiplier
		Gas	Oil	Elec	Coal		Gas ¢/100 cu. ft.	Oil ¢/gal.	Elec ¢/Kwh	Coal ¢/lb.	Gas	Oil	Elec	Coal	
		A	B	C	D	E	F	G	H	I	J	K	L	M	N
CONNECTICUT	New Haven	.58	.67	1.77	–	.13	30.09	46.87	4.26	–	.0192	.0143	.4155	–	.0312
DELAWARE	Dover	.28	.64	.65	–	.07	15.30	45.55	1.60	–	.0188	.0140	.4054	.1770	.0447
D.C.	Washington	.41	.55	1.12	.69	.18	25.26	45.92	3.22	4.55	.0161	.0120	.3473	.1517	.0559
FLORIDA	Miami	.10	.04	.07	–	.49	10.00	52.96	3.07	–	.0010	.0007	.0211	–	.1589
	Tallahasee	.09	.25	.37	–	.23	13.90	48.78	2.49	–	.0068	.0051	.1465	–	.0941
GEORGIA	Atlanta	.14	40	–	.49	–	12.50	43.50	–	4.63	.0113	.0092	.2435	.1063	.0612
	Savannah	.10	.23	–	–	–	12.50	37.81	–	–	.0083	.0062	.1794	–	0892
IDAHO	Boise	.39	.52	.36	–	.03	23.62	42.06	1.01	–	.0166	.0124	.3582	–	.0330
ILLINOIS	Chicago	.35	.60	.54	.54	.05	19.25	44.19	1.38	3.12	.0182	.0136	.3944	.1722	.0373
	Springfield	.26	.44	.77	.33	.12	19.16	42.79	2.59	2.52	.0138	.0103	.2976	1300	.0453
	Cairo	.22	.40	.82	.24	.20	17.85	42.79	3.04	2.00	.0125	.0093	.2692	.1176	.0663
INDIANA	Indianapolis	.30	.50	.48	.50	.05	18.27	41.60	1.33	3 25	.0168	.0124	.3514	.1534	.0398
IOWA	Des Moines	.28	.58	–	–	–	14.92	41.32	–	–	.0188	.0140	.4062	–	.0406
	Dubuque	.24	.65	–	–	–	11.24	41.32	–	–	.0210	.0151	.4548	–	.0257
KANSAS	Wichita	.15	.41	.49	–	.09	9.70	36.42	1.49	–	.0151	.0112	.3255	–	.0603
	Goodland	.14	.48	.38	–	.03	8.16	36.42	1.00	–	.0175	.0133	.3780	–	.0337
KENTUCKY	Lexington	.26	.50	.63	–	.08	17.26	43.75	1.90	–	.0153	.0114	.3300	1441	.0423
LOUISIANA	Baton Rouge	.05	–	.28	–	.19	7.10	–	1.82	–	.0071	–	.1539	–	.1046
	Shreveport	.08	–	.38	–	.16	7.50	–	1.77	–	.0100	–	.2155	–	.0914
MAINE	Portland	.65	.72	1.04	–	.03	28.00	44.70	2.25	–	.0231	.0161	.4631	–	.0138
MARYLAND	Baltimore	.45	.58	.98	.51	.12	27.12	46.74	2.71	3.25	.0167	0124	.3603	1573	.0461
MASSACHUSETTS	Worcester	.73	.77	1.09	–	.06	32.14	45.78	3.02	–	.0227	0169	.4911	–	.0185
MICHIGAN	Lansing	.56	.65	1.10	.70	.05	28.47	43.86	2.60	3.75	.0197	.0147	4260	.1860	.0200
MINNESOTA	Duluth	.60	.76	–	–	–	23.80	43.09	–	–	.0254	.0177	.5482	–	0073
	Minneapolis	.33	.72	–	–	–	15.59	46.18	–	–	.0213	.0156	.4595	–	.0268
MISSISSIPPI	Jackson	.11	–	.57	–	.24	10.50	–	2.58	–	.0102	–	.2209	.0904	.0918
MISSOURI	St. Louis	.21	.76	.39	–	.06	14.12	45.63	1.18	–	.0153	.0167	.3306	–	.0540
	Springfield	.17	.49	.45	–	.07	10.50	41.37	1.30	–	.0160	.0119	3453	–	0518
MONTANA	Helena	.26	–	.69	–	.01	12.45	–	1.55	–	.0206	–	4456	–	0093
NEBRASKA	Omaha	.33	.58	.73	–	.08	17.65	40.90	1.80	–	.0189	.0141	.4077	–	.0446
	Scottsbluff	.25	.52	.68	–	.04	14.00	41.35	1.87	–	.0169	.0126	3658	–	.0232
NEVADA	Elko	.33	.63	.71	–	.02	17.75	44.34	1.75	–	0188	.0141	4075	–	0128
	Las Vegas	.14	.34	.46	–	.23	13.90	44.34	2.08	–	.0103	.0077	.2228	–	1114
NEW HAMPSHIRE	Concord	.70	.73	1.05	–	.04	33.29	46.38	2.30	–	0211	.0157	4552	–	.0170
NEW JERSEY	Atlantic City	.62	.62	1.20	.56	.09	33.84	45.32	3.02	3.25	.0183	.0137	.3957	1728	.0312
NEW MEXICO	Raton	.17	–	1.03	–	.09	8.60	–	2.35	–	.0203	–	4388	–	0391
	Silver City	.09	–	.69	–	.10	7.05	–	2.63	–	.0121	–	2611	–	.0391
NEW YORK	New York City	.65	.68	1.72	.76	.19	35.28	49.46	4.34	4.40	.0183	.0137	.3959	1729	.0434
	Rochester	.53	.76	1.36	.82	.07	24.05	46.53	2.85	3.95	.0220	.0164	4755	.2076	0259
NORTH CAROLINA	Raleigh	.30	.52	.95	.64	.12	19.41	45.10	2.35	4.40	.0155	0115	3347	1462	.0500
	Wilmington	.17	.35	.54	.70	.17	15.46	43.43	2.35	4.76	.0107	0080	2315	1011	0730
NORTH DAKOTA	Bismarck	.59	–	1.21	–	.04	26.50	–	2.49	–	.0224	–	4852	–	0171
OHIO	Youngstown	.19	.69	1.18	.36	.05	8.88	43.95	2.62	1.80	.0209	.0156	4522	1974	.0204
	Cincinnati	.18	.47	.52	.53	.07	12.79	43.95	1.68	3.90	.0144	0107	.3107	1357	0439
OKLAHOMA	Oklahoma City	.21	–	.74	–	.20	17.45	–	2.80	–	.0121	–	2625	–	0705
OREGON	Salem	.57	.72	1.02	–	.02	26.41	44.20	2.17	–	.0217	.0162	4690	–	.0101
	Medford	.58	.75	1.05	–	.06	25.11	44.20	2.13	–	.0229	.0170	.4440	–	.0283
PENNSYLVANIA	Philadelphia	.49	.63	1.08	.61	.12	26.87	46.10	2.73	3.55	.0183	.0137	3959	1729	0448
	Pittsburgh	.35	60	1.04	.44	.03	19.25	44.75	2.68	2.60	.0180	.0134	3890	1698	.0120
RHODE ISLAND	Providence	.45	.68	1.37	–	.09	23.03	47.20	3 26	–	0194	0145	4195	–	.0285
SOUTH CAROLINA	Charleston	.19	.27	.44	–	.20	21.58	42.17	2.34	–	.0087	0065	1888	–	0869
	Greenville-Spartanburg	.18	.36	.56	–	.13	16.23	42.17	2.28	–	.0113	.0085	2450	–	0561
SOUTH DAKOTA	Rapid City	.22	.58	.79	–	.04	11.88	41.76	1.95	–	0186	.0139	.4027	–	.0209
TENNESSEE	Knoxville	.19	.44	.61	.31	.12	14.20	44.20	2.13	2.50	.0133	.0099	.2873	.1255	.0557
	Memphis	.11	.38	.55	.31	.17	9.25	42.36	2 13	2.80	.0119	0089	.2569	1122	.0780
TEXAS	Austin	.07	–	.51	–	.32	8.60	–	3.00	–	.0078	–	1688	–	1071
	Dallas	.07	–	.29	–	.16	7.90	–	1.49	–	.0090	–	1943	–	1049
	Houston	.05	–	.21	–	.16	9.00	–	1.62	–	.0061	–	1319	–	.1000
	Lubbock	.15	–	.53	–	.13	12.46	–	2.11	–	.0117	–	.2529	–	.0617
UTAH	Salt Lake City	.23	.58	.87	–	.08	11.56	39.60	2.05	–	.0197	0147	4264	–	.0371
	Milford	.28	–	.90	–	.05	13.39	–	1.97	–	.0212	–	4578	–	.0267
VERMONT	Burlington	.63	.84	1.20	–	.04	27.81	47.58	2.36	–	.0222	.0176	5098	–	0178
VIRGINIA	Richmond	.24	.50	.72	.61	.12	16.64	45.58	2.25	4 40	.0147	.0110	.3178	1388	.0537
WASHINGTON	Olympia	.75	.80	.79	–	.01	32.19	44.72	1.52	–	0239	.0178	5165	–	0035
	Walla Walla	.21	.46	.45	–	.05	15.40	44.72	1.51	–	.0137	0102	2963	–	.0357
WEST VIRGINIA	Charleston	.32	.50	.79	13	.10	21.92	45.73	2.50	.96	.0146	0109	.3154	.1377	0388
	Elkins	.44	63	1.10	.18	.06	23.82	45.73	2.76	1.05	.0185	.0138	3999	.1746	0208
WISCONSIN	Milwaukee	.44	.75	–	.79	–	20.29	46.10	–	3.85	0218	0162	4707	2055	0216
WYOMING	Casper	.32	–	.81	–	.03	16.90	–	2.00	–	.0188	–	4062	–	.0151

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PART 3: HOW TO DO IT

PART 3: HOW TO DO IT

This part is divided into sections, each one treating an energy-saving step—13 in all. A section works like this;

First, how hard is it ?

Should you do it yourself? -- a quick rundown to help you decide whether you can handle it yourself or if you need the services of a professional.

Then, how to get it done

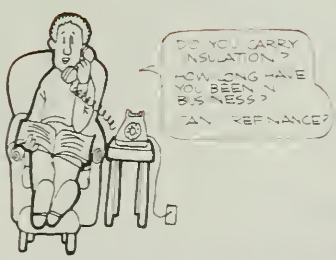
If you're doing it yourself:

- Tools you'll need
- Safety items to include
- What kind of materials
- How much material
- Getting it done, step by step

OR if you want to hire a contractor to do it, how to make sure he does the job right.

- What kind of materials
- How much material
- R-Value
- Signing a contract
- What to check

Last, more information you may need

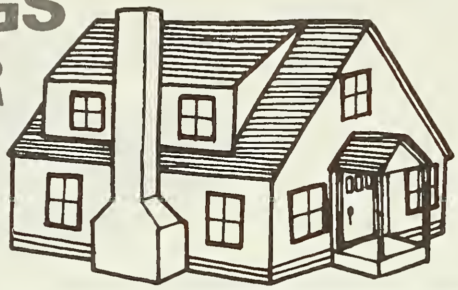


Some general information that could be helpful:

- Buying Insulating Materials
- Choosing a Contractor
- Getting Financing

TABLE OF CONTENTS

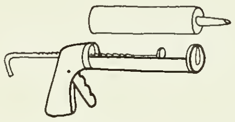
CAULK THE OPENINGS IN YOUR HOME



AN EASY DO-IT-YOURSELF PROJECT

Caulking should be applied wherever two different materials or parts of the house meet. It takes no specialized skill to apply and a minimum of tools.

Tools



1. Ladder
2. Caulking gun
3. Caulking cartridges
4. Oakum, glass fiber strips, caulking cotton, or sponge rubber
5. Putty knife or large screwdriver

Safety

You'll need to use a ladder to reach some of the areas which need to be caulked. Be sure you use it safely.

Level and block the ladder in place. Have a helper hold it if possible.

Don't try to reach that extra little bit – get down and move the ladder.

Carry your caulking gun with a sling so that you can use both hands climbing the ladder.

Where a house needs to be caulked

1. Between window drip caps (tops of windows) and siding.
2. Between door drip caps and siding.
3. At joints between window frames and siding.
4. At joints between door frames and siding.
5. Between window sills and siding.
6. At corners formed by siding.
7. At sills where wood structure meets the foundation.
8. Outside water faucets, or other special breaks in the outside house surface.
9. Where pipes and wires penetrate the ceiling below an unheated attic.
10. Between porches and main body of the house.
11. Where chimney or masonry meets siding.
12. Where storm windows meet the window frame, except for drain holes at window sill.
13. And if you have a heated attic; where the wall meets the eave at the gable ends.

Materials

What you'll need

Caulking compound is available in these basic types:

1. Oil or resin base caulk; readily available and will bond to most surfaces – wood, masonry and metal; not very durable but lowest in first cost for this type of application.
2. Latex, butyl or polyvinyl based caulk; all readily available and will bond to most surfaces, more durable, but more expensive than oil or resin based caulk.
3. Elastomeric caulks; most durable and most expensive; includes silicones, polysulfides and polyurethanes; the instructions provided on the labels should be followed.
4. Filler; includes oakum, caulking cotton, sponge rubber, and glass fiber types; used to fill extra wide cracks or as a backup for elastomeric caulks.

CAUTION: Lead base caulk is not recommended because it is toxic. Many states prohibit its use.

How much

Estimating the number of cartridges of caulking compound required is difficult since the number needed will vary greatly with the size of cracks to be filled. Rough estimates are:

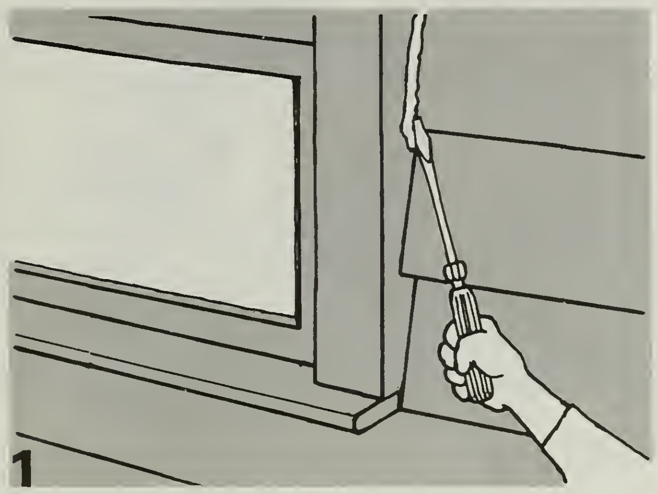
1/2 cartridge per window or door

4 cartridges for the foundation sill

2 cartridges for a two story chimney

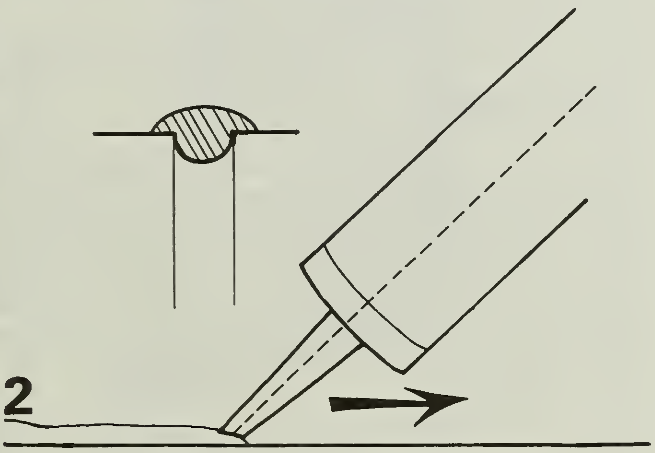
If possible, it's best to start the job with a half-dozen cartridges and then purchase more as the job continues and you need them.

Installation



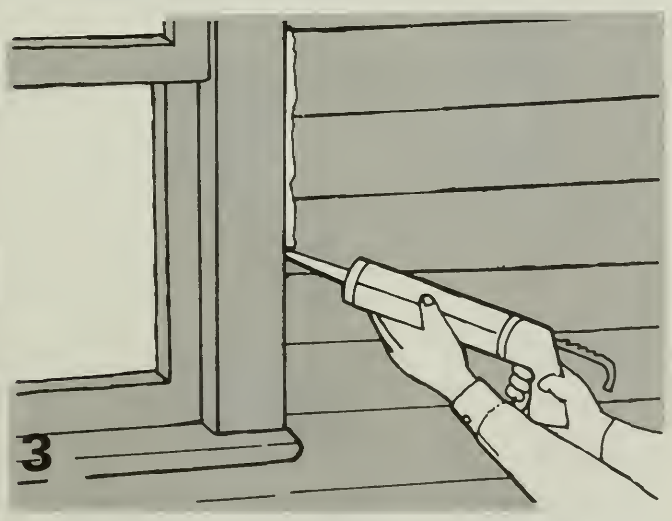
1

Before applying caulking compound, clean area of paint build-up, dirt, or deteriorated caulk with solvent and putty knife or large screwdriver.



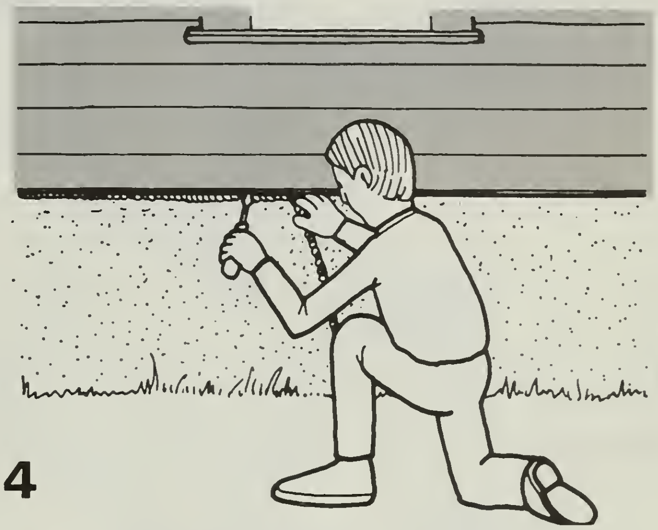
2

Drawing a good bead of caulk will take a little practice. First attempts may be a bit messy. Make sure the bead overlaps both sides for a tight seal.



3

A wide bead may be necessary to make sure caulk adheres to both sides.



4

Fill extra wide cracks like those at the sills (where the house meets the foundation) with oakum, glass fiber insulation strips, etc.)

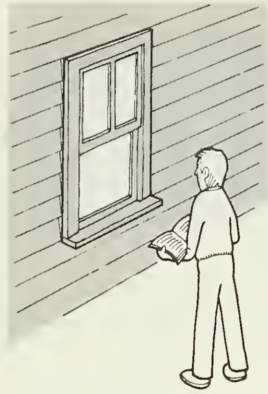
5

In places where you can't quite fill the gaps, finish the job with caulk.

6

Caulking compound also comes in rope form. Unwind it and force it into cracks with your fingers. You can fill extra long cracks easily this way.

WEATHERSTRIP YOUR WINDOWS



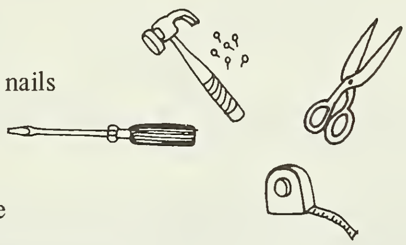
AN EASY DO-IT-YOURSELF PROJECT

Weatherstripping windows can be accomplished by even the inexperienced handyman. A minimum of tools and skills is required.

But before starting, make sure that both the moving parts of your windows (the sash), and the channels that the sash slide in aren't so rotted that they won't hold the small nails used for weatherstripping. If they are badly rotted, don't weatherstrip, but consider replacing the entire window unit first. Call your lumberyard or window dealer for an evaluation or cost estimate.

Tools

1. Hammer and nails
2. Screwdriver
3. Tin snips
4. Tape measure

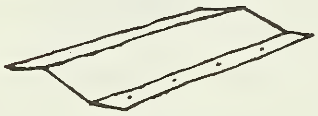


Safety

Upper story windows may be a problem. You should be able to do all work from inside, but avoid awkward leaning out of windows when tacking weatherstripping into place. If you find you need to use a ladder observe the precautions on page 34.

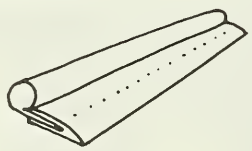
Materials

What you'll need



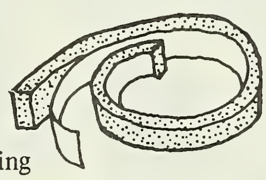
Thin spring metal

Installed in the channel of window so it is virtually invisible. Somewhat difficult to install. Very durable.



Rolled vinyl

With or without metal backing. Visible when installed. Easy to install. Durable.



Foam rubber with adhesive backing

Easy to install. Breaks down and wears rather quickly. Not as effective a sealer as metal strips or rolled vinyl.

Never use where friction occurs.

How much

Weatherstripping is purchased either by the running foot or in kit form for each window. In either case you'll have to make a list of your windows, and measure them to find the total length of weatherstripping you'll need. Measure the total distance around the edges of the moving parts of each window type you have, and complete the list below:

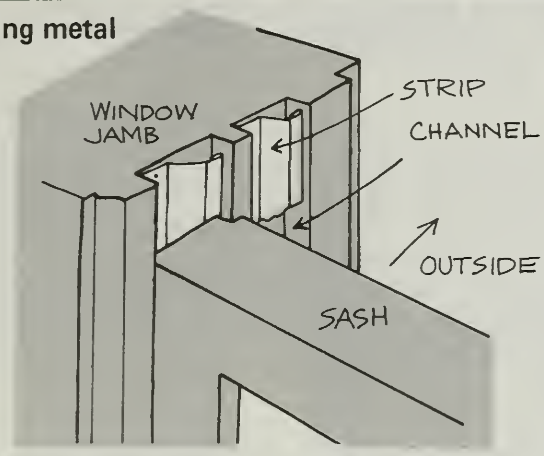
Type	Size	Quantity	X	length req'd	=	Total
1. Double-hung	1	(_____)	X	(_______)	=	_____
	2	(_____)	X	(_______)	=	_____
	3	(_____)	X	(_______)	=	_____
2. Casement	1	(_____)	X	(_______)	=	_____
	2	(_____)	X	(_______)	=	_____
	3	(_____)	X	(_______)	=	_____
3. Tilting	1	(_____)	X	(_______)	=	_____
	2	(_____)	X	(_______)	=	_____
	3	(_____)	X	(_______)	=	_____
4. Sliding pane	1	(_____)	X	(_______)	=	_____
	2	(_____)	X	(_______)	=	_____
	3	(_____)	X	(_______)	=	_____

Total length of weatherstripping required _____

Be sure to allow for waste. If you buy in kit form, be sure the kit is intended for your window type and size.

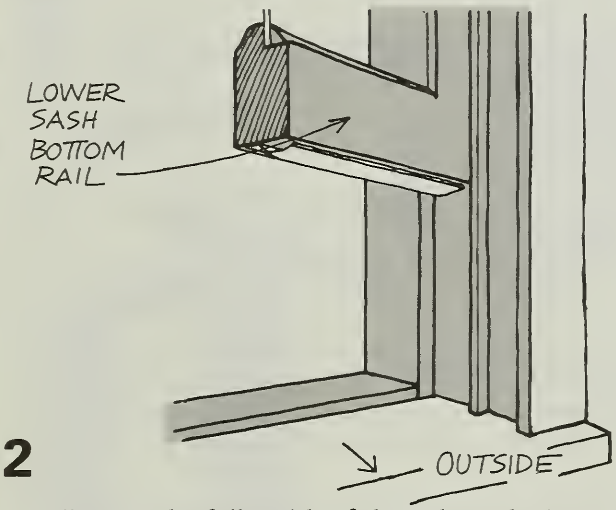
Installation

Thin spring metal



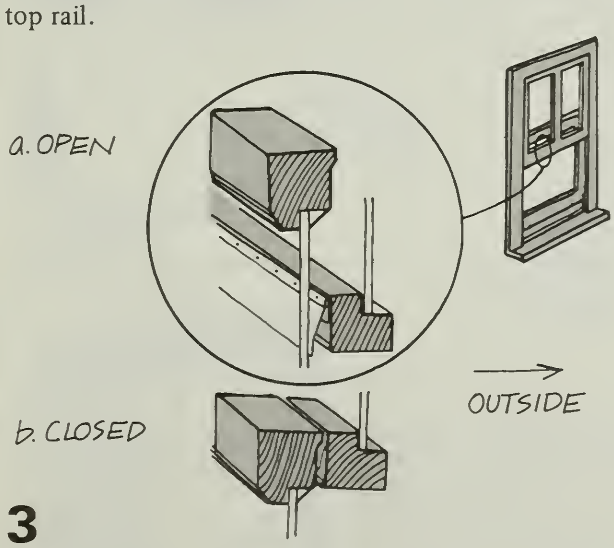
1

Install by moving sash to the open position and sliding strip in between the sash and the channel. Tack in place into the casing. Do not cover the pulleys in the upper channels.



2

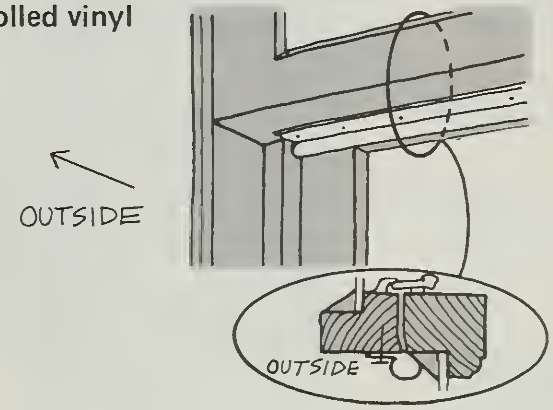
Install strips the full width of the sash on the bottom of the lower sash bottom rail and the top of the upper sash top rail.



3

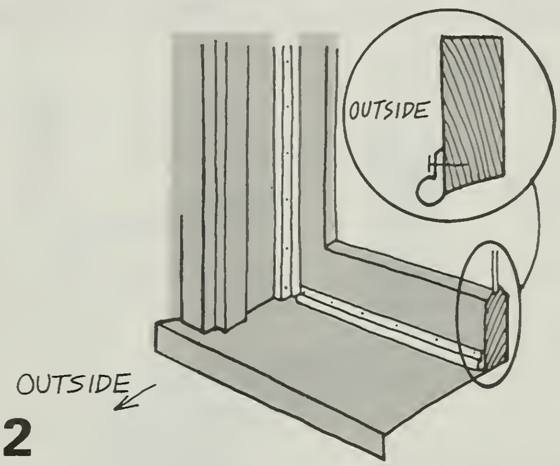
Then attach a strip the full width of the window to the upper sash bottom rail. Countersink the nails slightly so they won't catch on the lower sash top rail.

Rolled vinyl



1

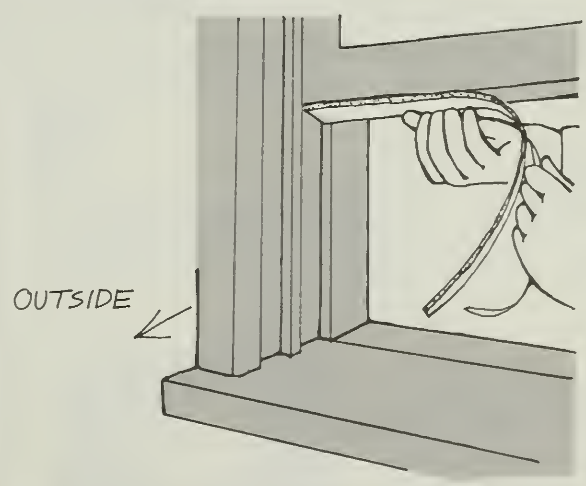
Nail on vinyl strips on double-hung windows as shown. A sliding window is much the same and can be treated as a double-hung window turned on its side. Casement and



2

tilting windows should be weatherstripped with the vinyl nailed to the window casing so that, as the window shuts, it compresses the roll.

Adhesive-backed foam strip



Install adhesive backed foam, on all types of windows, only where there is no friction. On double-hung windows, this is only on the bottom (as shown) and top rails. Other types of windows can use foam strips in many more places.

WEATHERSTRIP YOUR DOORS

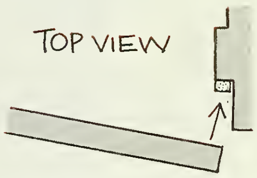
AN EASY DO-IT-YOURSELF PROJECT

You can weatherstrip your doors even if you're not an experienced handyman. There are several types of weatherstripping for doors, each with its own level of effectiveness, durability and degree of installation difficulty. Select among the options given the one you feel is best for you. The installations are the same for the two sides and top of a door, with a different, more durable one for the threshold.

The Alternative Methods and Materials

1. Adhesive backed foam:

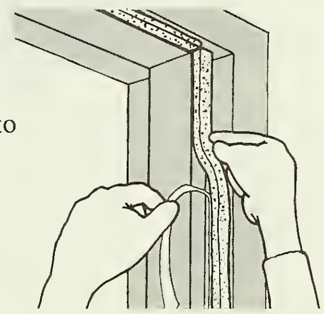
Tools



Knife or shears,
Tape measure

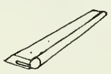
Evaluation — extremely easy to install, invisible when installed, not very durable, more effective on doors than windows.

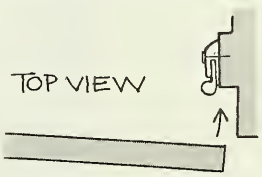
Installation — stick foam to inside face of jamb.



2. Rolled vinyl with aluminum channel backing:

Tools





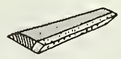
Hammer, nails,
Tin snips
Tape measure

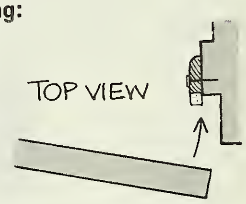
Evaluation — easy to install, visible when installed, durable.

Installation — nail strip snugly against door on the casing

3. Foam rubber with wood backing:

Tools





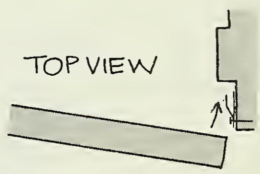
Hammer, nails,
Hand saw,
Tape measure

Evaluation — easy to install, visible when installed, not very durable.

Installation — nail strip snugly against the closed door. Space nails 8 to 12 inches apart.

4. Spring metal:

Tools



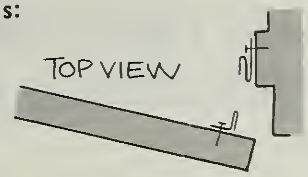
Tin snips
Hammer, nails,
Tape measure

Evaluation — easy to install, invisible when installed, extremely durable.

Installation — cut to length and tack in place. Lift outer edge of strip with screwdriver after tacking, for better seal.

Note: These methods are harder than 1 through 4.

5. Interlocking metal channels:



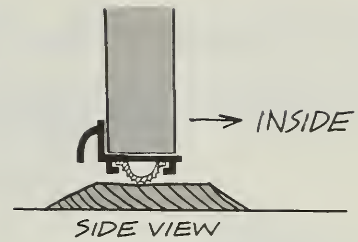
Tools

Hack saw,
Hammer, nails,
Tape measure

Evaluation — difficult to install (alignment is critical), visible when installed, durable but subject to damage, because they're exposed, excellent seal.

Installation — cut and fit strips to head of door first: male strip on door, female on head; then hinge side of door: male strip on jamb, female on door; finally lock side on door, female on jamb.

8. Door Shoes:

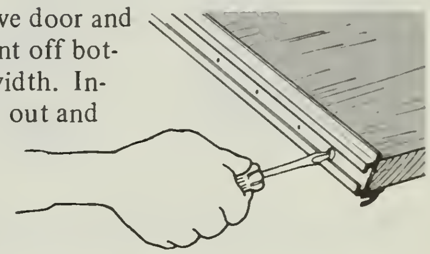


Tools

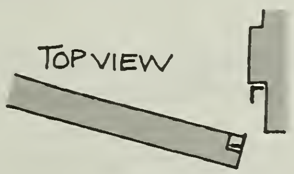
Screwdriver,
Hack saw,
Plane,
Tape measure

Evaluation — useful with wooden threshhold that is not worn, very durable, difficult to install (must remove door).

Installation — remove door and trim required amount off bottom. Cut to door width. Install by sliding vinyl out and fasten with screws.



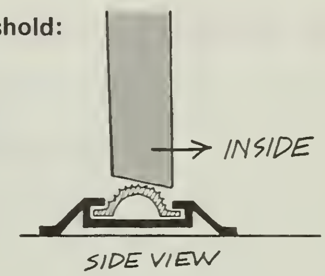
6. Fitted interlocking metal channels: (J-Strips)



Evaluation — very difficult to install, exceptionally good weather seal, invisible when installed, not exposed to possible damage.

Installation — should be installed by a carpenter. Not appropriate for do-it-yourself installation unless done by an accomplished handyman.

9. Vinyl bulb threshold:



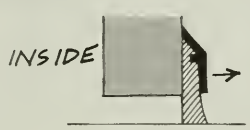
Tools

Screwdriver,
Hack saw,
Plane,
Tape measure

Evaluation — useful where there is no threshhold or wooden one is worn out, difficult to install, vinyl will wear but replacements are available.

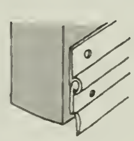
Installation — remove door and trim required amount off bottom. Bottom should have about 1/8" bevel to seal against vinyl. Be sure bevel is cut in right direction for opening.

7. Sweeps:



Tools

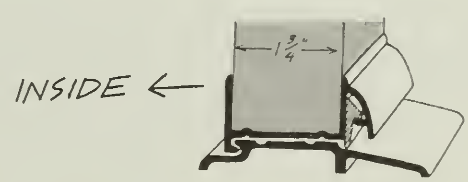
Screwdriver,
Hack saw,
Tape measure



Evaluation — useful for flat threshholds, may drag on carpet or rug.
Models that flip up when the door is opened are available (not illustrated).

Installation — cut sweep to fit 1/16 inch in from the edges of the door. Some sweeps are installed on the inside and some outside. Check instructions for your particular type.

10. Interlocking threshold:

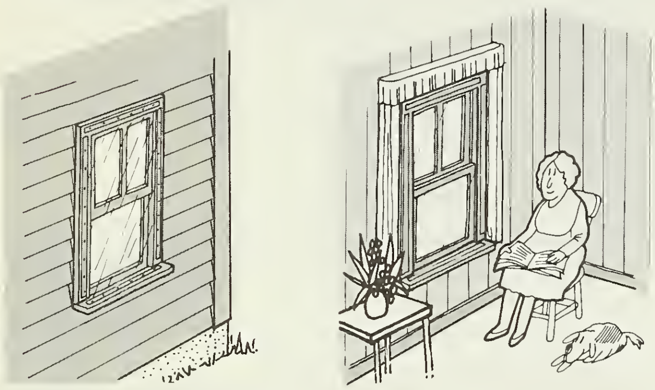


Evaluation — very difficult to install, exceptionally good weather seal.

Installation — should be installed by a skilled carpenter.

INSTALL PLASTIC STORM WINDOWS

AN EASY DO-IT-YOURSELF PROJECT



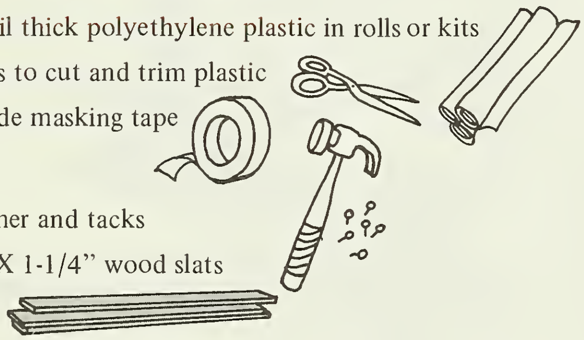
Tack the plastic sheets over the outside of your windows or tape sheets over the inside instead of installing permanent type storm windows.

Tools & Materials

1. Six-mil thick polyethylene plastic in rolls or kits
2. Shears to cut and trim plastic
3. 2" wide masking tape

OR

3. Hammer and tacks
4. 1/4" X 1-1/4" wood slats



Installation

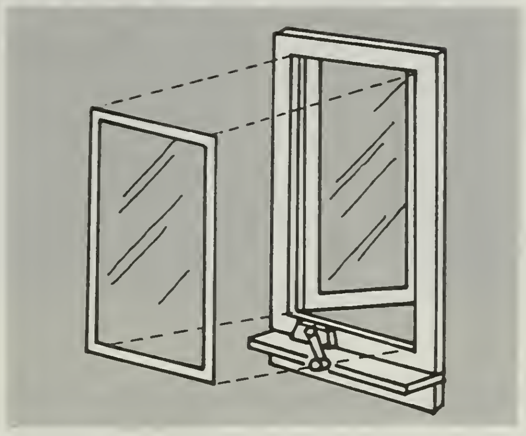
Measure the width of your larger windows to determine the width of the plastic rolls to buy. Measure the length of your windows to see how many linear feet and therefore how many rolls or the kit size you need to buy.

Attach to the inside or outside of the frame so that the plastic will block airflow that leaks around the moveable parts of the window. If you attach the plastic to the outside use the slats and tacks. If you attach it to the inside masking tape will work.

Inside installation is easier and will provide greater protection to the plastic. Outside installation is more difficult, especially on a 2 story house, and the plastic is more likely to be damaged by the elements.

Be sure to install tightly and securely, and remove all excess – besides looking better, this will make the plastic less susceptible to deterioration during the course of the winter.

INSTALL SINGLE PANE STORM WINDOWS



CONTRACTOR ASSEMBLY

DO-IT-YOURSELF INSTALLATION

Rigid Plastic: These are available in do-it-yourself kits.

Glass: Storm window suppliers will build single pane glass storm windows to your measurements that you then install yourself. Another method is to make your own with do-it-yourself materials available at some hardware stores.

Installation

Rigid Plastic: These are always installed on the inside. Follow the instructions on the do-it-yourself kit.

Glass: These can be installed either inside, if the way the window is built will permit it, or on the outside. If you install them on the inside, then you won't be able to open the existing window. If you install them on the outside, then they only cover the moving part of the window and you'll save less energy, but they will be permanently installed. With metal casement windows, exterior installation of single-pane storm windows is a job for a contractor.

Determine how you want the windows to sit in the frame. Your measurements will be the outside measurements of the storm window. Be as accurate as possible, then allow 1/8" along each edge for clearance. You'll be responsible for any errors in measurement, so do a good job.

When your windows are delivered, check the actual measurements carefully against your order.

Install the windows and fix in place with moveable clips so you can take them down for cleaning.

Advantages and Disadvantages

Single pane storm windows aren't as expensive as the double-track or triple-track combination windows (see page 42). The major disadvantage of the single pane windows is that you can't open them easily after they're installed.

Selection: Judging Quality

Frame finish (glass windows): A mill finish (plain aluminum) will oxidize quickly and degrade appearance. Windows with an anodized or baked enamel finish look better.

Weatherstripping: The side of the storm window frame which touches the existing window frame should have a permanently installed weatherstrip or gasket to make the joint as airtight as possible.

INSTALL COMBINATION STORM WINDOWS

NORMALLY CONTRACTOR INSTALLED

Triple track combination (windows and screen) storm windows are designed for installation over double-hung and sliding windows. They are permanently installed and can be opened at any time for ventilation.

Double-track combination units are also available and they cost less. Both kinds are sold almost everywhere, and can be bought with or without the cost of installation.

Installation

You can save a few dollars (10% to 15% of the purchase price) by installing the windows yourself. But you'll need some tools: caulking gun, drill, and screw driver. In most cases it will be easier to have the supplier install your windows for you, although it will cost more.

The supplier will first measure all the windows where you want storm windows installed. It will take anywhere from several days to a few weeks to make up your order before the supplier returns to install them.

Installation should take less than one day, depending on how many windows are involved. Two very important items should be checked to make sure the installation is properly done.

Make sure that both the window sashes and screen sash move smoothly and seal tightly when closed after installation. Poor installation can cause misalignment.

Be sure there is a *tightly* caulked seal around the edge of the storm windows. Leaks can hurt the performance of storm windows a lot.

NOTE: **Most combination units will come with two or three 1/4" dia. holes (or other types of vents) drilled through the frame where it meets the window sill. This is to keep winter condensation from collecting on the sill and causing rot. Keep these holes clear, and drill them yourself if your combination units don't already have them.**

Selection: Judging Quality

Frame finish: A mill finish (plain aluminum) will oxidize, reducing ease of operation and degrading appearance. An anodized or baked enamel finish is better.

Corner joints: Quality of construction affects the strength and performance of storm windows. Corners are a good place to check construction. They should be strong and air tight. Normally overlapped corner joints are better than mitered. If you can see through the joints, they will leak air.

Sash tracks and weatherstripping: Storm windows are supposed to reduce air leakage around windows. The depth of the metal grooves (sash tracks) at the sides of the window and the weatherstripping quality makes a big difference in how well storm windows can do this. Compare several types before deciding.

Hardware quality: The quality of locks and catches has a direct effect on durability and is a good indicator of overall construction quality.

INSTALL COMBINATION STORM DOORS

NORMALLY CONTRACTOR INSTALLED

Combination (windows and screen) storm doors are designed for installation over exterior doors. They are sold almost everywhere, with or without the cost of installation.

Installation

You can save a few dollars (10% to 15% of the purchase price) by installing doors yourself. But you'll need some tools: hammer, drill, screw driver, and weatherstripping. In most cases, it will be easier to have the supplier install your doors himself.

The supplier will first measure all the doors where you want storm doors installed. It will take anywhere from several days to a few weeks to make up your order before the supplier returns to install them. Installation should take less than one-half day.

Before the installer leaves, be sure the doors operate smoothly and close tightly. Check for cracks around the jamb and make sure the seal is as air-tight as possible. Also, remove and replace the exchangeable panels (window and screen) to make sure they fit properly and with a weather tight seal.

Selection: Judging Quality

Door finish: A mill finish (plain aluminum) will oxidize, reducing ease of operation and degrading appearance. An anodized or baked enamel finish is better.

Corner joints: Quality of construction affects the strength and effectiveness of storm doors. Corners are a good place to check construction. They should be strong and air tight. If you can see through the joints, they will leak air.

Weatherstripping: Storm doors are supposed to reduce air leakage around your doors. Weatherstripping quality makes a big difference in how well storm doors can do this. Compare several types before deciding.

Hardware quality: The quality of locks, hinges and catches should be evaluated since it can have a direct effect on durability and is a good indicator of overall construction quality.

Construction material: Storm doors of wood or steel can also be purchased within the same price range as the aluminum variety. They have the same quality differences and should be similarly evaluated. The choice between doors of similar quality but different material is primarily up to your own personal taste.

BUYING INSULATION

From the pages in Part 3 that deal with insulating your house you can get a good idea of what your choice of insulating materials is (see "Materials" at the beginning of each how-to section), how many square feet you need, and whether you need a vapor barrier with your insulation. There are three more things you need to know before you buy:

1. **What the R-Value of the insulation should be** – your money's worth in insulation is measured in R-Value. R-Value is a number that tells you how much resistance the insulation presents to heat flowing through it. The bigger the R-Value, the better the insulation. This page lists recommended R-Values for the different parts of the house.

2. **What kind of insulation to buy** – pages 45 and 46 will help you choose the right kind of insulation for the job you want to do.

3. **How thick your insulation should be** – For the R-Value and type of insulation you're going to buy, look at the table at the bottom of page 46 – it'll tell you how many inches of each type of insulation it takes to achieve the R-Value you need.

NOTE: If you have a choice of insulating materials, and all your choices are available in your area, simply price the same R-Value for both, and get the better buy. Pay more only for more R-Value.

1. What the R-Value of the insulation should be:

UNFINISHED ATTIC, NO FLOOR

Batts, blankets or loose fill in the floor between the joists:

THICKNESS OF EXISTING INSULATION	HOW MUCH TO ADD	HOW MUCH TO ADD IF YOU HAVE ELECTRIC HEAT OR IF YOU HAVE OIL HEAT AND LIVE IN A COLD CLIMATE*	HOW MUCH TO ADD IF YOU HAVE ELECTRIC HEAT AND LIVE IN A COLD CLIMATE**
0"	R-38	R-38	R-38
0"-2"	R-22	R-30	R-38
2"-4"	R-11	R-11	R-30
4"-6"	R-11	R-11	R-19
6"-8"	None	None	R-11

***Add this much if:**

A. You're doing it yourself and your Heating and Cooling Factors add up to more than 0.4, or

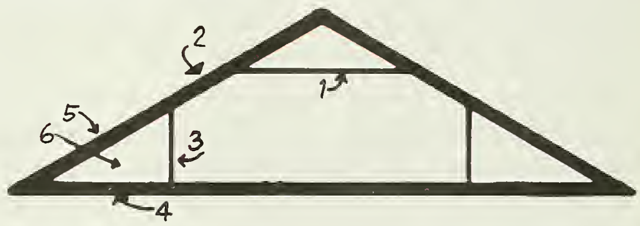
B. You're hiring a contractor and your Heating and Cooling Factors add up to more than 0.6.

****Add this much if:**

A. You're doing it yourself and your Heating and Cooling Factors add up to more than 0.7, or

B. You're hiring a contractor and your Heating and Cooling Factors add up to more than 1.0.

FINISHED ATTIC



1. Attic Ceiling – see the table at the left under Unfinished Attic, No Floor.
2. Rafters – contractor fills completely with blow-in insulation.
3. Knee Walls – Insulate (5), Outer Attic Rafters instead.
4. Outer Attic Floors – Insulate (5), Outer Attic Rafters instead.
5. Outer Attic Rafters – Add batts or blankets: If there is existing insulation in (3) and (4), add R-11. If there is no existing insulation in (3) and (4), add R-19.
6. End Walls – Add batts or blankets, R-11.

UNFINISHED ATTIC WITH FLOOR

A. Do-it-yourself or Contractor Installed:

Between the collar beams – follow the guidelines above in Unfinished Attic, No Floor.

Rafters and end walls – buy insulation thick enough to fill the space available (usually R-19 for the rafters and R-11 for the end walls).

B. Contractor Installed

Contractor blows loose-fill insulation under the floor. Fill this space completely — see page 44 for the R-Value you should get.

FRAME WALLS — contractor blows in insulation to fill the space inside the walls. See page 44 for the R-Value you should get.

CRAWL SPACE — R-11 batts or blankets against the wall and the edge of the floor.

FLOORS — R-11 batts or blankets between the floor joists, *foil-faced.*

BASEMENT WALLS — R-11 batts or blankets between wall studs.

2. What kind of insulation to buy:

BATTS— glass fiber, rock wool

Where they're used to insulate:

unfinished attic floor

unfinished attic rafters

underside of floors

best suited for standard joist or rafter spacing of 16" or 24", and space between joists relatively free of obstructions

cut in sections 15" or 23" wide, 1" to 7" thick, 4' or 8' long

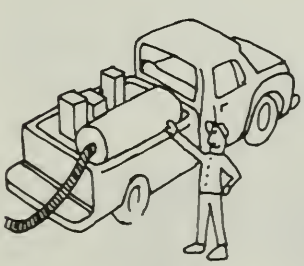
with or without a vapor barrier backing — if you need one and can't get it, buy polyethylene except that to be used to insulate the underside of floors

easy to handle because of relatively small size

use will result in more waste from trimming sections than use of blankets

fire resistant, moisture resistant

FOAMED IN PLACE— ureaformaldehyde-based



Where it's used to insulate:

finished frame walls

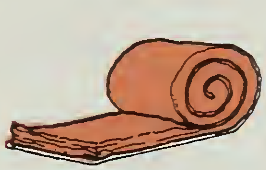
moisture resistant, fire resistant

may have higher insulating value than blown-in materials

more expensive than blown-in materials

quality of application to date has been very inconsistent — choose a qualified contractor who will guarantee his work.

BLANKETS— glass fiber, rock wool



Where they're used to insulate:

unfinished attic floor

unfinished attic rafters

underside of floors

best suited for standard joist or rafter spacing of 16" or 24", and space between joists relatively free of obstructions

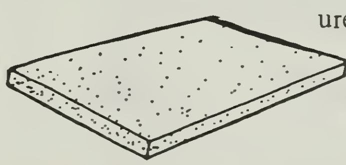
cut in sections 15" or 23" wide, 1" to 7" thick in rolls to be cut to length by the installer

with or without a vapor barrier backing

a little more difficult to handle than batts because of size

fire resistant, moisture resistant

RIGID BOARD— extruded polystyrene bead board (expanded polystyrene) urethane board, glass fiber



Where it's used to insulate:

basement wall

NOTE: Polystyrene and urethane rigid board insulation should only be installed by a contractor. They must be covered with 1/2" gypsum wallboard to assure fire safety.

extruded polystyrene and urethane are their own vapor barriers, bead board and glass fiber are not.

high insulating value for relatively small thicknesses, particularly urethane.

comes in 24" or 48" widths

variety of thicknesses from 3/4" to 4"

LOOSE FILL (poured-in)— glass fiber, rock wool, cellulosic fiber, vermiculite, perlite

Where it's used to insulate:

unfinished attic floor

vapor barrier bought and applied separately

best suited for non-standard or irregular joist spacing or when space between joists has many obstructions

glass fiber and rock wool are fire resistant and moisture resistant

cellulosic fiber chemically treated to be fire resistant and moisture resistant; treatment not yet proven to be heat resistant, may break down in a hot attic; check to be sure that bags indicate material meets Federal Specifications. If they do, they'll be clearly labelled.

cellulosic fiber has about 30% more insulation value than rock wool for the same installed thickness (this can be important in walls or under attic floors).

vermiculite is significantly more expensive but can be poured into smaller areas.

vermiculite and perlite have about the same insulating value.

all are easy to install.

LOOSE FILL (blown-in)— glass fiber, rock wool, cellulosic fiber

Where it's used to insulate

unfinished attic floor

finished attic floor

finished frame walls

underside of floors

vapor barrier bought separately

same physical properties as poured-in loose fill.

Because it consists of smaller tufts, cellulosic fiber gets into small nooks and corners more consistently than rock wool or glass fiber when blown into closed spaces such as walls or joist spaces.

When any of these materials are blown into a closed space enough must be blown in to fill the whole space.

3. How thick your insulation should be:

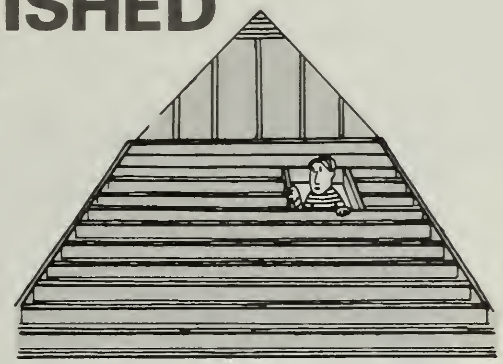
Get the R-Value you need from page 44, and the type of insulation you need from this page and the one before. Use the table below to find out how thick the insulation you buy should be:

TYPE OF INSULATION

	BATTS OR BLANKETS 		LOOSE FILL (POURED-IN) 			
	glass fiber	rock wool	glass fiber	rock wool	cellulosic fiber	
R-11	3½"-4"	3"	5"	4"	3"	R-11
R-19	6"-6½"	5¼"	8"-9"	6"-7"	5"	R-19
R-22	6½"	6"	10"	7"-8"	6"	R-22
R-30	9½"-10½"*	9"*	13"-14"	10"-11"	8"	R-30
R-38	12"-13"*	10½"*	17"-18"	13"-14"	10"-11"	R-38

*** two batts or blankets required.**

INSULATE YOUR UNFINISHED ATTIC



AN EASY DO-IT-YOURSELF PROJECT

Install batts or blankets between the joists or trusses in your attic

OR

Pour in loose fill between the joists or trusses

OR

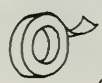
Lay in batts or pour in loose fill over existing insulation if you've decided you don't have enough already. *Don't* add a vapor barrier if you're installing additional insulation.

NOTE: If your attic has trusses in it, this section still applies – the insulation goes in the same place, but job is more difficult.

Tools

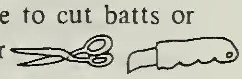
1. Temporary lighting
2. Temporary flooring

3. Duct or masking tape (2" wide)



4. Heavy duty staple gun and staples, or hammer and tacks

5. Heavy duty shears or linoleum knife to cut batts or blankets and plastic for vapor barrier



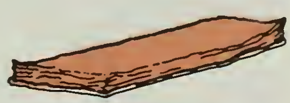
Safety

1. Provide good lighting
2. Lay boards or plywood sheets down over the tops of the joists or trusses to form a walkway (the ceiling below won't support your weight).
3. Be careful of roofing nails protruding through roof sheathing.
4. If you use glass fiber or mineral wool, wear gloves and breathing mask, and keep the material wrapped until you're ready to put it in place.

Materials

What you'll need

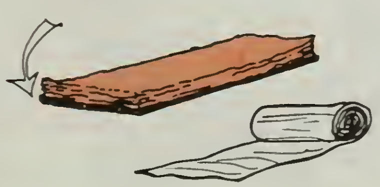
Batts, glass fiber or rock wool



Blankets, glass fiber or rock wool

Loose fill, rock wool, cellulosic fiber, or vermiculite

Vapor barriers



How much

(a) Accurately determine your attic area.

If necessary, divide it into rectangles and sum the areas.

________ X ________ = ________

________ X ________ = ________

________ X ________ = ________

Total = ________

(b) Insulation area = (.9) X (total) = ________

(c) Vapor barrier area (see if you need one - page 54).

1. Batts or blankets with vapor barrier backing – use insulation area.
2. Polyethylene (for use with loose fill, or if backed batts or blankets are not available) – use insulation area, but plan on waste since the polyethylene will be installed in strips between the joists or trusses, and you may not be able to cut an even number of strips out of a roll.

(d) Insulation thickness – see page 44. If page 44 calls for R-30 or more, you may be adding two layers of insulation. Lay the first layer between the joists or trusses, and the second layer across them. *Only* the first layer should have a vapor barrier underneath it. The second layer should be an unfaced batt or blanket, loose fill, or a faced batt or blanket with the vapor barrier slashed freely.

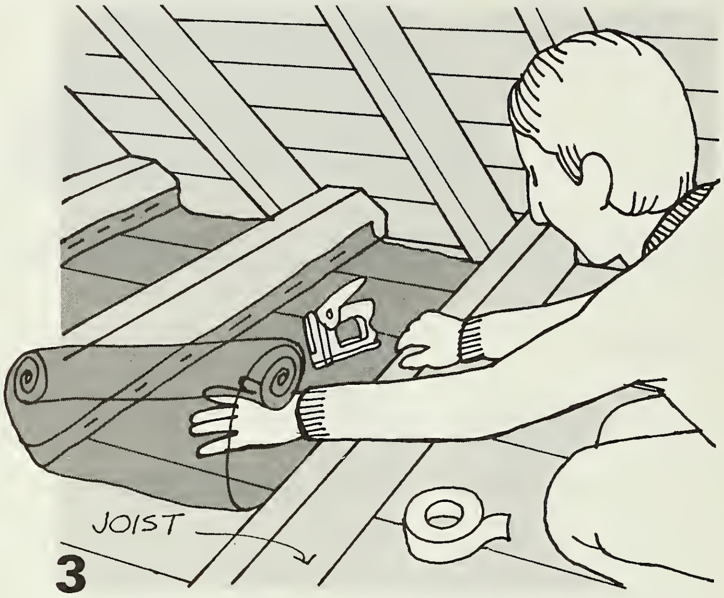
Installation

Preparation

Put in temporary lighting and flooring, check for leaks and check need for ventilation and vapor barrier (see page 54). Seal all places where pipes or wires penetrate the attic floor. **NOTE:** Some manufacturers may recommend using polyethylene in a continuous sheet across the joists or trusses. If you aren't adding insulation that covers the tops of these framing members with at least 3½" of insulation, laying a continuous sheet may cause condensation along them; lay strips as shown instead.

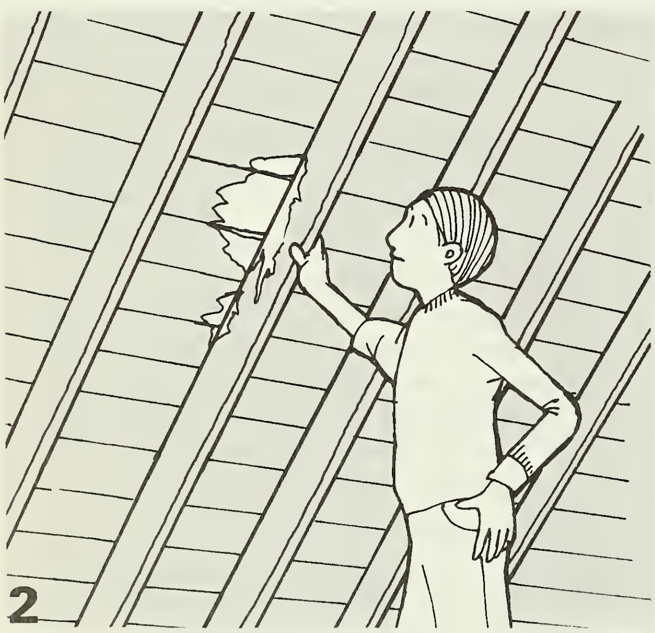
1

Install temporary flooring and lights. Keep insulation in wrappers until you are ready to install. It comes wrapped in a compressed state and expands when the wrappers are removed.



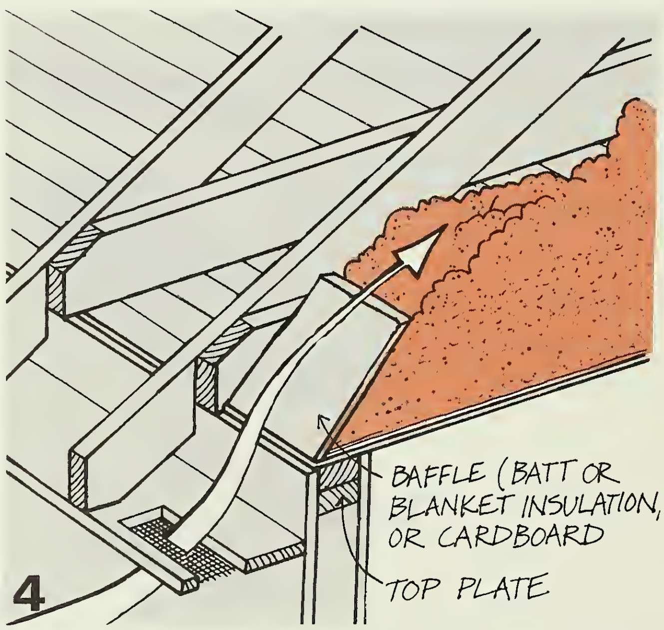
3

Install separate vapor barrier if needed (see page 54). Lay in polyethylene strips between joists or trusses. Staple or tack in place. Seal seams and holes with tape. (Instead of taping, seams may be overlapped 6").



2

Check for roof leaks, looking for water stains or marks. If you find leakage, make repairs before you insulate. Wet insulation is ineffective and can damage the structure of your home.



4

If you're using loose fill, install baffles at the inside of the eave vents so that the insulation won't block the flow of air from the vents into the attic. Be sure that insulation extends out far enough to cover the top plate.

Installing the insulation

Either lay in batts or blankets between the joists or pour in loose fill. If you're using batts or blankets with a vapor barrier, place the barrier on the side toward the living area.

Lay in blankets or batts between joists or trusses. (Note: batts and blankets are slightly wider than joist spacing so they'll fit snugly). If blankets are used, cut long runs first to conserve material, using leftovers for shorter spaces. Slide insulation under wiring wherever possible.

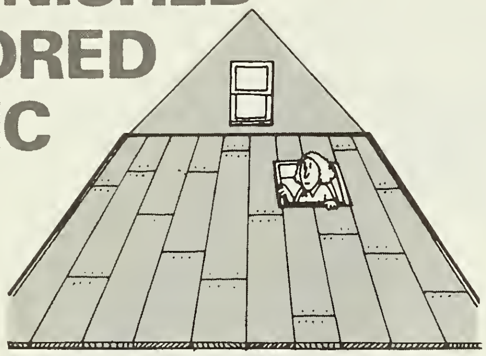
OR

Pour in loose fill insulation to the depth required. If you are covering the tops of the joists, a good way to get uniform depth is to stretch two or three strings the length of the attic at the desired height, and level the insulation to the strings. Use a board or garden rake. Fill all the nooks and crannies, but don't cover recessed light fixtures, exhaust fans, or attic ventilation.

The space between the chimney and the wood framing should be filled with *non-combustible* material, preferably unfaced batts or blankets. Also, the National Electric Code requires that insulation be kept 3" away from light fixtures.

Cut ends of batts or blankets to fit snugly around cross bracing. Cut the next batt in a similar way to allow the ends to butt tightly together. If page 44 calls for an R-Value that requires a second layer, place it **at right angles** to the joists.

INSULATE YOUR UNFINISHED FLOORED ATTIC



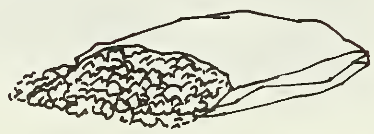
TWO OPTIONS AVAILABLE

1. **CONTRACTOR INSTALLED:** blow-in insulation under the flooring and between the joists.
2. **DO IT YOURSELF OR CONTRACTOR:** install batts between the rafters, collar beams, and the studs on the end walls.

CONTRACTOR INSTALLED

Types of materials contractors use

Blown-in insulation
- glass fiber
- rock wool
- cellulosic fiber



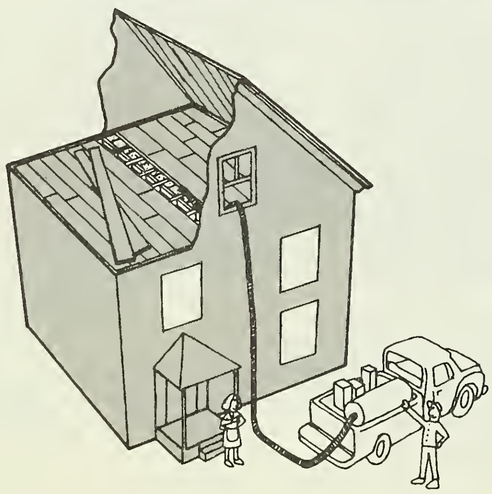
Preparation

Do you need ventilation in your attic? See page 54.

Check for roof leaks, looking for water stains or marks. If you can find any leaks, make repairs before you insulate. Wet insulation is useless and can damage the structure of your house.

What your contractor will do

The insulation is installed by blowing the insulating material under air pressure through a big flexible hose into the spaces between the attic floor and the ceiling of the rooms below. Bags of insulating material are fed into a blowing machine that mixes the insulation with air and forces it through the hose and into place. Before starting



the machine, the contractor will locate the cross bracing between the joists in the attic. He'll then remove the floor boards above the cross bracing and install the insulation by blowing it in on each side of the cross bracing to make sure there are no spaces left unfilled. Since there's no effective way to partially fill a space, all of the spaces should be completely filled to ensure proper coverage. Normally the job will take no longer than a day.

What you should check

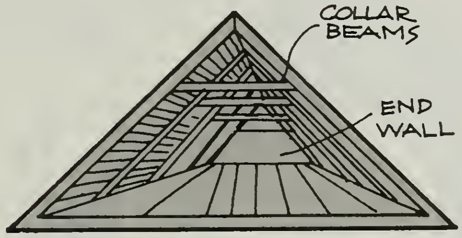
First be very careful about choosing a contractor. See page 66 for advice on how to make a selection.

Before you sign an agreement with your contractor, decide how much and what kind of insulation you're buying and make sure it's included in the contract. Insulation material properly installed will achieve a single insulating value (R-Value) for the depth of your joist space. You should agree on what that insulating value is with the contractor, before the job begins. Next check a bag of the type of insulation he intends to use. On it, there will be a table which will indicate how many square feet of attic floor that bag is meant to cover while achieving the desired insulating value. The information may be in different forms (number of square feet per bag or number of bags per 1000 square feet), so you may have to do some simple division to use the number correctly. Knowing this and the area of your attic, you should be able to figure out how many bags must be installed to give you the desired R-Value. This number should be agreed upon between you and the contractor before the job is begun. While the job is in progress, be sure the right amount is being installed. There's nothing wrong with having the contractor save the empty bags so that you can count them (5 bags more or less than the amount you agreed on is an acceptable difference from the estimate).

After the job is finished, it's a good idea to drill 1/4" diameter holes in the floor about a foot apart. This will help prevent condensation from collecting under the floor in winter.

DO-IT-YOURSELF

Install batts or blankets in your attic between the rafters and collar beams, and the studs on the end walls.



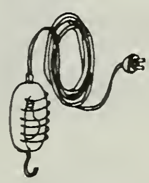
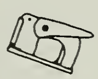
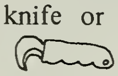
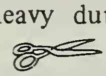
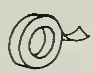
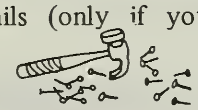
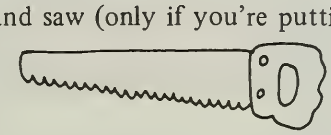
This measure will involve installing 2x4 beams which span between each roof rafter at ceiling height, if your attic doesn't already have them. This gives you a ventilation space above for the insulation (see page 54).

NOTE: **The materials, methods, and thicknesses of insulation are the same for both do-it-yourself and contractor jobs. For advice on choosing a contractor, see page 66.**

Safety

1. Provide good lighting
2. Be careful of roofing nails protruding through the roof sheathing
3. If you use glass fiber or mineral wool, wear gloves and a breathing mask and keep the material wrapped until you're about to use it

Tools

1. Temporary lighting 
2. Heavy duty staple gun and staples 
3. Linoleum knife or heavy duty shears to cut the insulation  
4. Duct or masking tape (2" wide) 
5. Hammer, nails (only if you're putting in collar beams) 
6. Power or hand saw (only if you're putting in collar beams) 

Materials

What you'll need

Buy either batts or blankets, made out of glass fiber or rock wool.

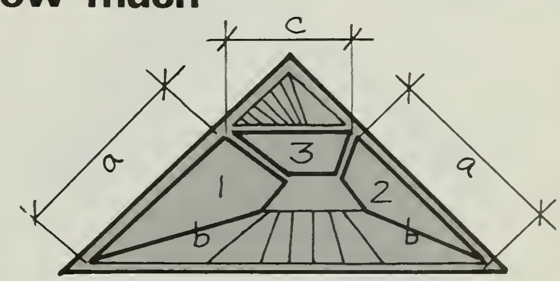
Do you need insulation with an attached vapor barrier? Follow the guidelines on page 54.

> **Exception:** For the area between the collar beams, if you're laying the new insulation on top of old insulation, buy insulation without a vapor barrier if possible, or slash the vapor barrier on the new insulation.

How Thick?

1. For the area between the collar beams, follow the guidelines on page 44. ("Existing insulation" means either insulation between the collar beams or in the attic floor.)
2. For the rafters and end walls, buy insulation that's thick enough to fill up the rafter and stud spaces. If there's some existing insulation in there, the combined thickness of the new and old insulation together should fill up the spaces.

How much



1. Figure out the area you want the insulation to cover between your rafters and collar beams (shown above). In general, figure each area to be covered, and add the areas up. If your attic is like the one shown, measure distances a, b, and c, enter them below, and do the figuring indicated (the .9 allows for the space taken up by rafters or collar beams.):

________ x ________ x .9 = ________
distance a × distance b × .9 = Area 1

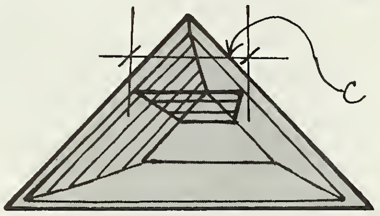
________ x ________ x .9 = ________
distance a × distance b × .9 = Area 2

________ x ________ x .9 = ________
distance b × distance c × .9 = Area 3
\+ ________

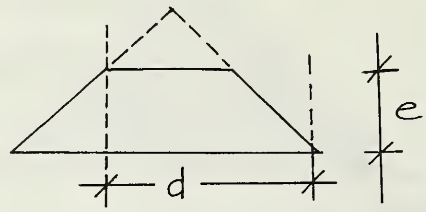
TOTAL [ ]

total area of insulation needed for rafters and collar beams.

2. Calculate the length of 2x4 stock you'll need for collar beams. Measure the length of span you need between rafters (c) and count the number of collar beams you need to install. Multiply to get the length of stock you need. You can have the lumber yard cut it to length at a small charge. If you cut it yourself, allow for waste. If you plan to finish your attic, check with your lumber yard to make sure 2" X 4" 's are strong enough to support the ceiling you plan to install.



3. Figure out the area of each end wall you want to insulate. Measure (d) and (e) and multiply to determine the area. Multiply by (.9) to correct for the space taken up by the studs, then multiply by the number of end walls.

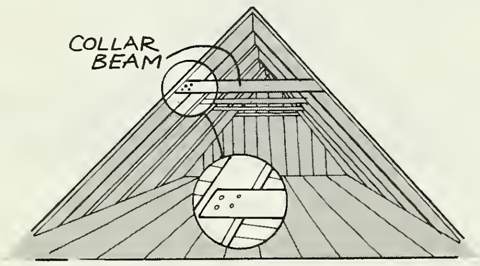


_______ x .9 x _______ = _______
area   number of end walls   area required

Installation

Preparation

Check for roof leaks, looking for water stains or marks. If you can find any leaks, make repairs before you insulate. Wet insulation is useless and can damage the structure of your house. Determine your need for more ventilation by referring to page 54. Put up your temporary lights and:

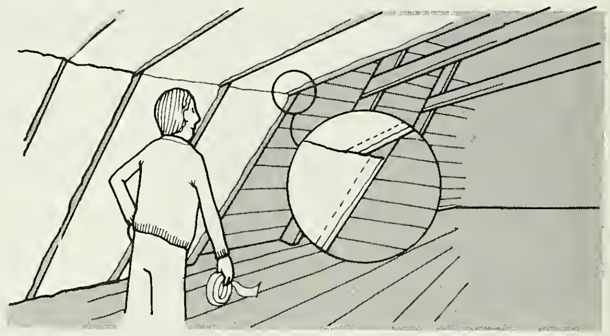


1. Install 2x4 collar beams spanning from rafter to rafter at the ceiling height you want. Every pair of rafters should have a collar beam spanning between them.

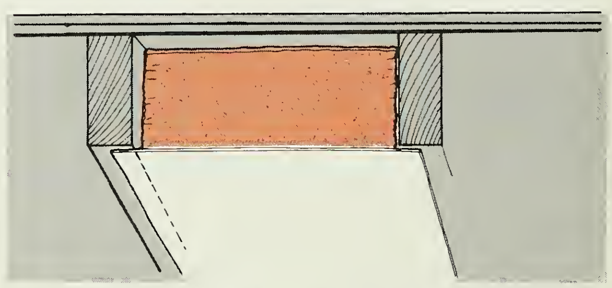
   Note: If you're installing new insulation over existing insulation:

Between the Rafters and Between the End Wall Studs, cut the old insulation loose where it has been stapled, push it to the back of the cavities, and slash the old vapor barrier (if any) before you lay the new insulation over it.

Between the Collar Beams, lay the new insulation above the old. Lay it over the tops of the collar beams in an unbroken layer at right angles to the beams. Use insulation that does not have a vapor barrier for this part of the job. If you can't get insulation without a vapor barrier, slash the vapor barrier before laying it down, so that moisture won't get trapped in the insulation.

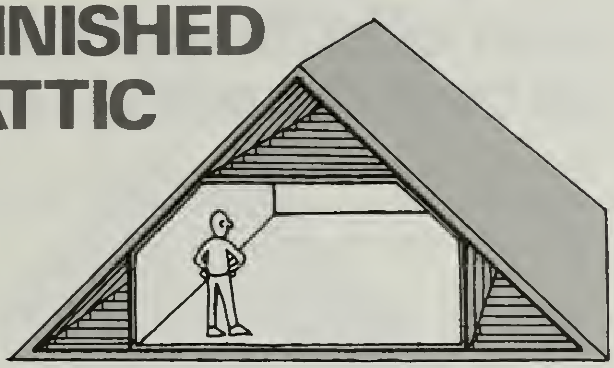


2. Install batts or blanket sections in place between the rafters and collar beams. Install with the vapor barrier on the inside, the side toward you. Don't try to use a continuous length of insulation where the collar beams meet the rafters. It will only result in gaps that are very hard to fill. Install batts in the end walls the same way. Be sure to trim carefully to fit the angles on the end walls.



3. Install batts or blanket sections by stapling the facing flange to the *edge* of the rafter or collar beam. Don't staple to the outside of the rafters; the vapor barrier will have a break at every rafter; and you may compress the insulation against the sheathing, reducing its insulating value.

INSULATE YOUR FINISHED ATTIC



TWO OPTIONS AVAILABLE

(and worth considering if there's under 4 inches of insulation already there.)

1. **Contractor Installation:** insulation blown into the ceiling, sloping rafters and outer attic floors; batts installed in the knee walls.

2. **Do-it-yourself:** installation of batts, blankets or loose fill in all attic spaces you can get to.

Where the insulation needs to be installed

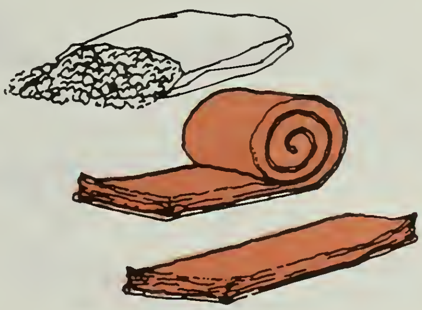
1. Attic Ceiling
2. Rafters
3. Knee Walls
4. Outer Attic Floors, or
5. Outer Attic Rafters
6. End Walls

CONTRACTOR INSTALLED

Types of materials contractors use

Blown-in insulation
glass fiber
rock wool

Batts or blankets
glass fiber
rock wool



Preparation

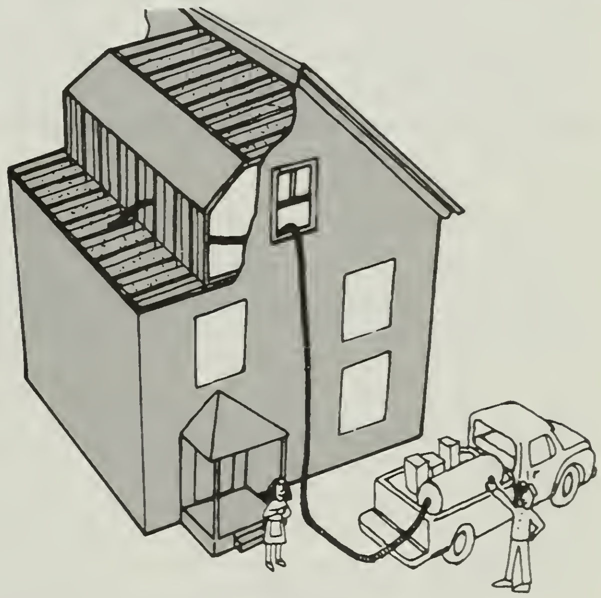
How thick should the insulation be? See page 44.

Check your need for ventilation and a vapor barrier. See page 54.

Check for roof leaks, looking for water stains or marks. If you can find any leaks, make repairs before you insulate. Wet insulation is useless and can damage the structure of your house.

What your contractor will do

Your contractor will blow insulation into the open joist spaces above your attic ceiling, between the rafters, and into the floor of the outer attic space, then install batts in the knee walls. If you want to keep the outer attic spaces heated for storage or any other purpose, you should have the contractor install batts between the outer attic rafters instead of insulating the outer floors and knee walls.



Page 50 describes how blown-in insulation is installed under an unfinished attic floor. This process is much the same for open joists with no floor over them. Pages 51-52 describe the right way to install batts.

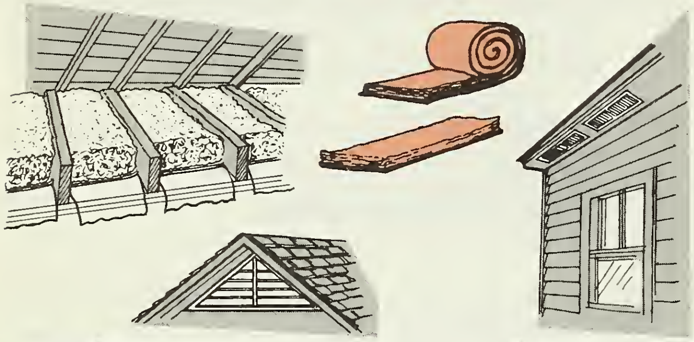
DO-IT-YOURSELF

You can insulate wherever you can get into the unfinished spaces.

Installing insulation in your attic ceiling is the same as installing it in an unfinished attic. Look at pages 47-49 to see how this is done.

If you want to insulate your outer attic spaces yourself, install batts between the rafters and the studs in the small triangular end walls. Look at page 52 to see how to do this.

DO YOU NEED A VAPOR BARRIER OR MORE VENTILATION IN YOUR ATTIC?



CONTRACTOR INSTALLED OR DO-IT-YOURSELF

Whenever you add insulation to your house, you should consider the need for a vapor barrier or more ventilation where you're doing the work.

A vapor barrier will prevent water vapor from condensing and collecting in your new insulation or on the beams and rafters of your house.

Added ventilation will remove water vapor before it gets a chance to condense and will also increase summer comfort by cooling off your attic.

What you need

If you're insulating your attic and:

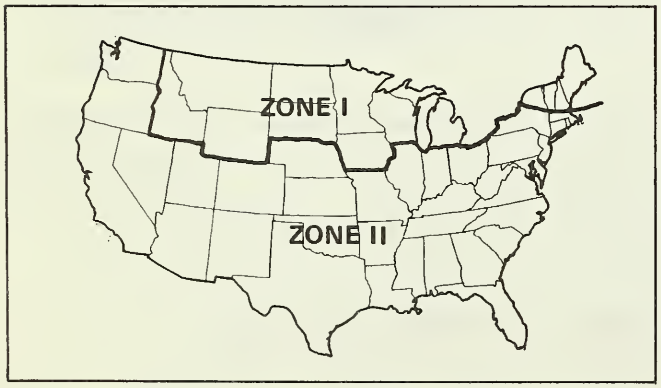
. . . you live in Zone I

1. Install a vapor barrier (unless you are blowing insulation into a finished attic)
2. Add ventilation area equal to 1/300 your attic floor area if:

    Signs of condensation occur after one heating season

    OR

    You can't install a vapor barrier with your insulation



. . . if you live in Zone II and don't have air conditioning

1. Install a vapor barrier toward the living space if you are insulating a finished attic (with other attics a vapor barrier is optional).
2. Add ventilation area equal to 1/300 your attic floor area if signs of condensation occur after one heating season.

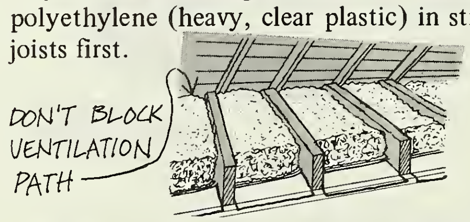
. . . you live in Zone II and have air conditioning

1. Install a vapor barrier toward the living space if you are insulating a finished attic (with other attics a vapor barrier is optional).
2. Add ventilation area equal to 1/150 your attic floor area.

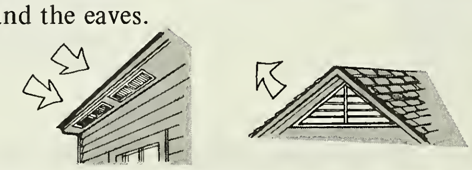
What should be installed

Vapor barriers: If you are installing batt or blanket insulation, and you need a vapor barrier, buy the batts or blankets with the vapor barrier attached. Install them with the vapor barrier side toward the living space.

If you are installing a loose fill insulation, lay down polyethylene (heavy, clear plastic) in strips between the joists first.



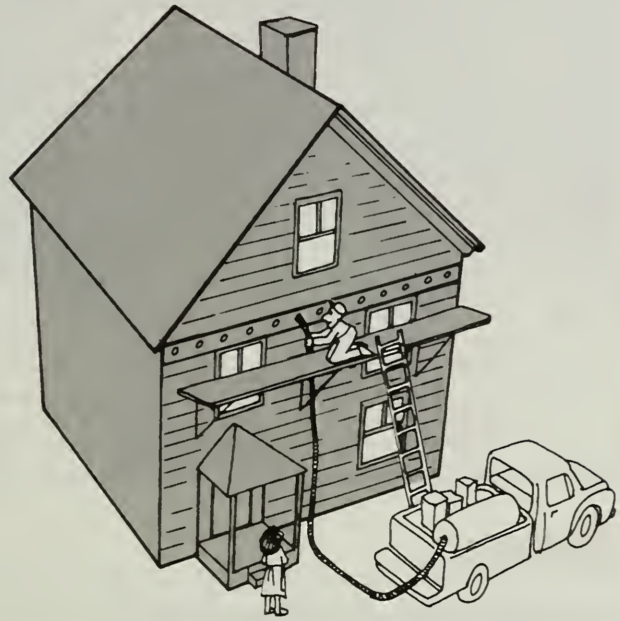
Ventilation: Install ventilation louvers (round or rectangular) in the eaves and gables (ridge vents are also available but are more difficult and costly to install in your house). The total open area of these louvers should be either 1/300 or 1/150 of your attic area (see "What You Need" above), and evenly divided between the gables and the eaves.



Ventilation louvers should be installed by a carpenter unless you are an experienced handyman.

Don't Block Ventilation Path with Insulation.

INSULATE YOUR WOOD FRAME WALLS



CONTRACTOR INSTALLED

Normally, insulating material is blown or pumped into the spaces in a wood frame wall through holes drilled from the outside or from the inside.

NOTE: Condensation in insulated walls may be a problem; see box on condensation, p.19.

Types of materials contractors use

Blow-in insulation:

glass fiber

rock wool

cellulosic fiber

Foam-in insulation:

plastic foam installed as a foam under slight pressure which hardens to form insulation. Quality of application to date has been very inconsistent – ask your local HUD/FHA office to recommend a qualified installer.

What your contractor will do

The contractor will measure the area you want insulated to determine how much material he will need and to estimate the cost. To install the insulation, the contractor must be able to get all the spaces in the wall. For each space he must drill a hole, usually in the outside wall, after removing the finished layer (usually clapboard or shingle). This always amounts to a lot of holes, but once the job is complete, a good contractor will leave no traces behind.

If you have brick veneer on the exterior, the procedure is much the same, except that it may be cheaper to do it from the inside.

Once the holes in the wall have been made your contractor is then ready to install the insulation. If the insulation is blown-in insulation he'll be following the process outlined on page 50. If he's using foam, he'll pump the foam into the wall spaces through a flexible hose with an applicator. With either method, each space will be completely filled, and the siding replaced.

What you should check

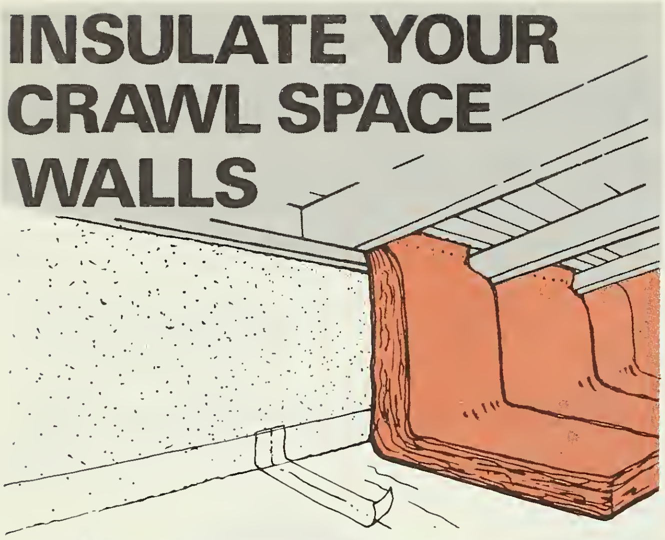
First be very careful about selecting a contractor. See page 66 for advice on how to make a choice.

Before you sign an agreement with your contractor, define what you're buying and make sure it's spelled out in the contract. Insulation material properly installed will add an R-Value of 8 for rock wool, 10 for cellulosic fiber, or 11.5 for ureaformaldehyde in a standard wood frame wall. You should agree on what that R-Value is with the contractor before the job begins. Next, check a bag of the type of insulation he intends to use (there will only be bags of mineral fiber or cellulosic fiber – there's no good way to check quantity with foam). On it, there will be a table which will indicate how many square feet of wall space that bag is meant to fill while giving your house the desired R value. The information may be in different forms (number of square feet per bag or number of bags per 1000 square feet), so you may have to do some simple division to use the number correctly.

Knowing this and the area of your walls, you should be able to figure out about how many bags should be installed to give you the desired R-value.

This number should be agreed upon between you and the contractor before the job is begun. While the job is in progress be sure the correct amount is being installed. There's nothing wrong with having the contractor save the empty bags so you can count them – 4 or 5 bags more or less than the amount you agreed on is an acceptable difference from the estimate.

INSULATE YOUR CRAWL SPACE WALLS



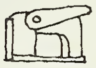
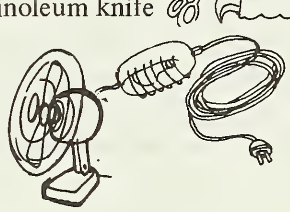
TWO OPTIONS AVAILABLE

(1) **Do-It-Yourself:** Install batt or blanket insulation around the walls and perimeter of your crawl space. Lay a plastic vapor barrier down on the crawl space earth.

(2) **Contractor Installed:** If your crawl space presents access or working space problems, you may want to consider having a contractor do the work for you. The contractor will probably follow a method similar to the do-it-yourself method described below. But if he suggests something different, have him price both methods and show you which is better. See page 66 for advice on how to select a contractor.

> **NOTE:** **The method of insulation shown here should not be used by residents of Alaska, Minnesota, and northern Maine. The extreme frost penetration in these areas can cause heaving of the foundation if the insulation method shown here is used. Residents of these areas should contact local HUD/FHA field offices for advice.**

Tools

1. Staple gun 
2. Heavy duty shears or linoleum knife 
3. Temporary lighting
4. Portable fan or blower to provide ventilation 
5. Tape measure 
6. Duct or Masking Tape (2" wide) 

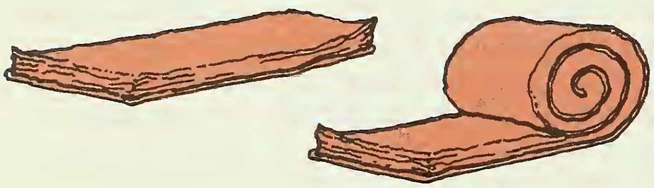
Safety

1. Provide adequate temporary lighting
2. Wear gloves and a breathing mask when working with glass fiber or rock wool
3. Provide adequate ventilation
4. Keep lights, fan, and all wires well off wet ground

Materials

What you'll need

1. R11 (3-3½" thick) blankets of rock wool or glass fiber; without a vapor barrier



2. Six mil polyethylene plastic to lay on earth for vapor barrier (mil's are a measure of thickness)

How much

1. Determine area to be insulated; measure the length and average height of the wall to be insulated; add 3' to the height (for perimeter insulation) and multiply the two to find total insulation area

   (length) X (height + 3′) = area

   _______ X _____ + 3′ = _______

2. Determine the area to be covered by the vapor barrier by finding the area of your crawl space

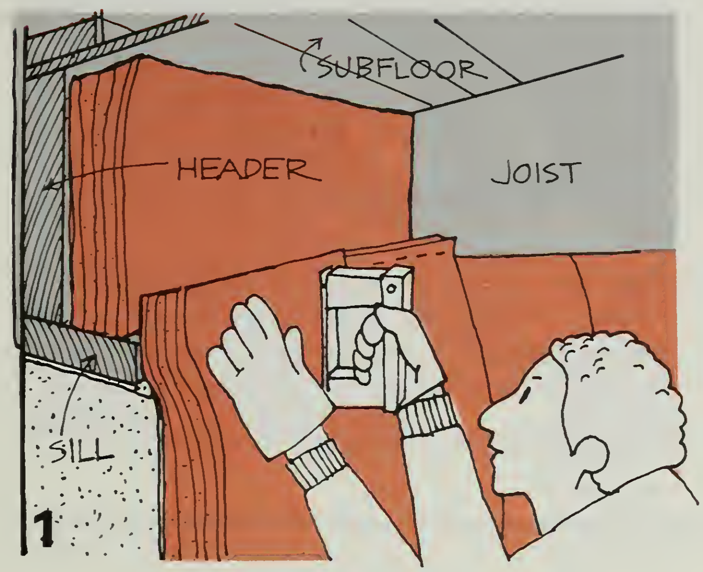
   (length) X (width) = area

   _______ X ______ = ________

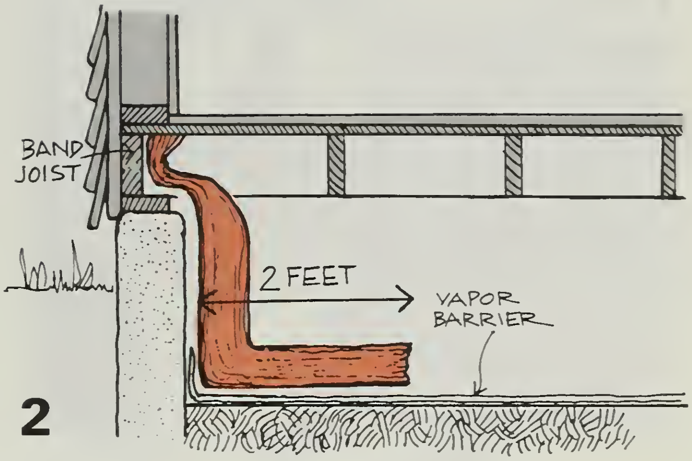
You may have to divide your crawl space into several rectangles — measure them and add up the areas.

(length)	X	(width)	=	
______	X	_______	=	________
______	X	_______	=	________
______	X	_______	+=	________
		TOTAL AREA	=	☐

Installation



Drawing 1: Where the joists run at right angles to the wall, press short pieces of insulation against the header – they should fit snugly. Then install the wall and perimeter insulation by stapling the top of each strip to the sill. Make sure the batts fit snugly against each other, and that you cut them long enough to cover 2 feet of floor as in Drawing 2.



Drawing 2: Where the joists run parallel to the wall, you don't need the short pieces of insulation, just install the wall and perimeter insulation by stapling the top of each strip to the band joist.

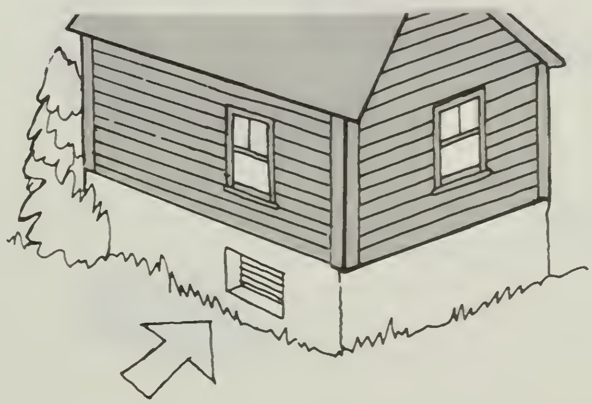
When all batts have been installed, lay down the polyethylene vapor barrier, tucking it under the batts all the way to the foundation wall. Turn it up at least 6" at the wall. Tape the joints of the vapor barrier or lap them at least 6". Plan your work to minimize stepping or crawling on the vapor barrier.

VENTILATING YOUR CRAWL SPACE

Even with a plastic vapor barrier on the floor, the air in your crawl space will be too damp if fresh air doesn't get in there from time to time. This will mean your new insulation will be wet, and it won't keep your house as warm. It will also mean that wooden members that hold up your house will be wet, and they'll rot. Proper ventilation will prevent both of these problems:

1. If your crawl space is part of your forced-air heating system (in other words, if air from your furnace moves through it), seal your crawl space as tightly as possible--- the air moving through it from your furnace is enough ventilation in winter. If you have crawl space vents, keep them shut in winter, open in summer. If there are no vents, run the blower on your furnace 3 or 4 times during the summer to keep the air in the crawl space from getting too damp.

2. All other crawl spaces should have vents in them that can be opened in summer (to clear out the damp air), and closed **tightly** in winter to make the most of your new insulation. You can make a cover for them to install in winter. Note: Your furnace may get its combustion air from the crawl space. If so, some of the vents should be left open. Check with your local HUD/FHA office.



INSULATE YOUR FLOOR

TWO OPTIONS AVAILABLE

1. DO-IT-YOURSELF

Install batts or blankets between the floor joists by stapling wire mesh or chicken wire to the bottom of the joists and sliding the batts or blankets in on top of the wire. Place vapor barrier up.

The job is quite easy to do in most cases. If you are insulating over a crawl space there may be some problems with access or working room, but careful planning can make things go much more smoothly and easily.

Check your floor joist spacing – this method will work best with standard 16" or 24" joist spacing. If you have non-standard or irregular spacing there will be more cutting and fitting and some waste of material.

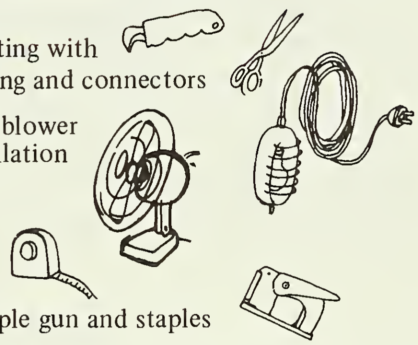
2. CONTRACTOR INSTALLED

See page 59.

DO-IT-YOURSELF

Tools

1. Heavy duty shears or linoleum knife
2. Temporary lighting with waterproof wiring and connectors
3. Portable fan or blower to provide ventilation
4. Tape measure
5. Heavy duty staple gun and staples



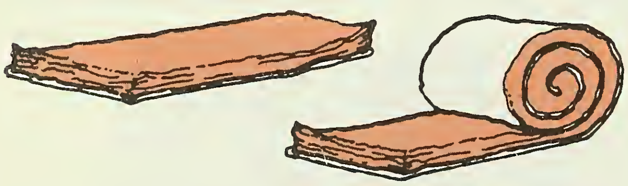
Safety

1. Provide adequate temporary lighting
2. Wear gloves and breathing mask when working with glass fiber or rock wool
3. Provide adequate ventilation
4. Keep lights and all wires off wet ground

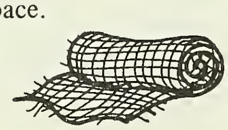
Materials

What you'll need

1. R11 (3"-3½") batts or blankets or rock wool or glass fiber, preferably with foil facing (See Installation).



2. Wire mesh or chicken wire of convenient width for handling in tight space.



How much

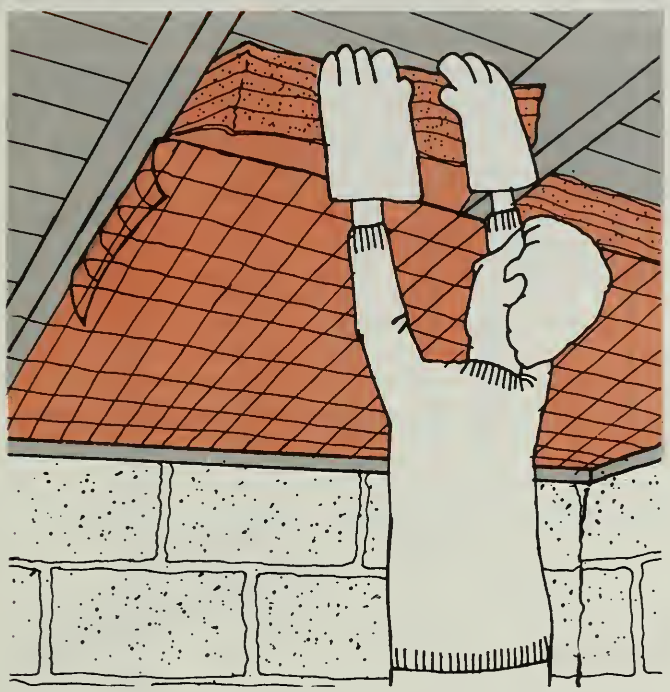
Determine the area to be insulated by measuring the length and width and multiplying to get the area.

(length) X (width) = area
(_____) X (_____) = ________

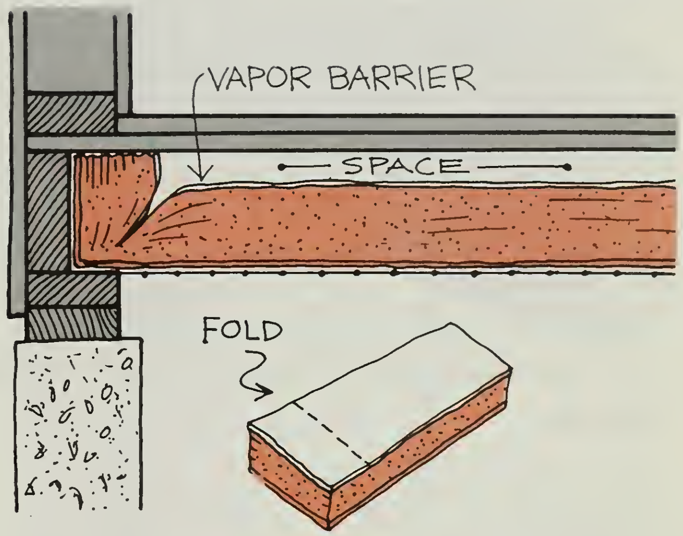
You may find it necessary to divide the floor into smaller areas and add them.

(length) X (width) = area
(_____) X (_____) = ________
(_____) X (_____) = ________
(_____) X (_____) = ________ +
total area = ________
(.9)(total area) = area of insulation
(.9)(________) = ________
total area = area of wire mesh or chicken wire

Installation

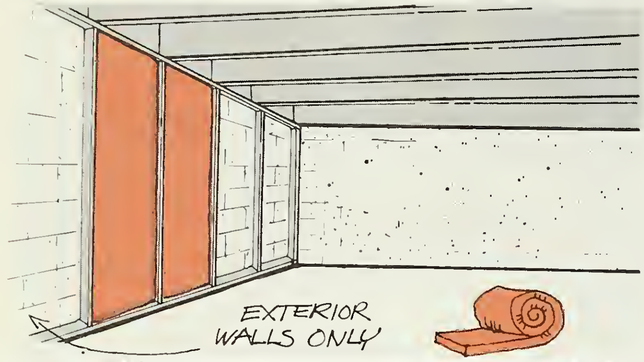


Start at a wall at one end of the joists and work out. Staple the wire to the bottom of the joists, and at right angles to them. Slide batts in on top of the wire. Work with short sections of wire and batts so that it won't be too difficult to get the insulation in place. Plan sections to begin and end at obstructions such as cross bracing.



Buy insulation with a vapor barrier, and install the vapor barrier facing up (next to the warm side) leaving an air space between the vapor barrier and the floor. Get foil-faced insulation if you can; it will make the air space insulate better. Be sure that ends of batts fit snugly up against the bottom of the floor to prevent loss of heat up end. Don't block combustion air openings for furnaces.

INSULATE YOUR BASEMENT WALLS

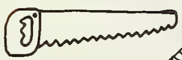
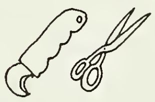
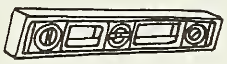


A MODERATELY EASY DO-IT-YOURSELF PROJECT

Install 2" X 4" studs (needed for thickness of insulation) along the walls to be insulated. Add glass fiber insulation between the studs. If you wish, finish with wallboard or panelling. The thickness of the finished wall material will determine the spacing of the studs..

> **NOTE:** The method of insulation shown here should not be used by residents of Alaska, Minnesota, and northern Maine. The extreme frost penetration in these areas can cause heaving of the foundation if the insulation method shown here is used. Residents of these areas should contact local HUD/FHA field offices for advice.

Tools

1. Saw  
2. Hammer, nails
3. Heavy duty staple gun, or hammer and tacks 
4. Tape measure 
5. Linoleum knife or heavy duty shears 
6. Level 
7. Small sledge hammer, masonry nails 

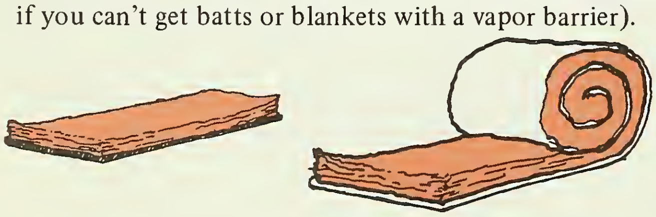
Safety

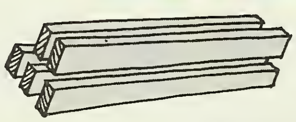
1. Provide adequate temporary lighting
2. If you use glass fiber or rock wool, wear gloves and a breathing mask, and keep the material wrapped until you are ready to use it

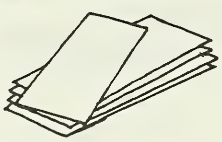
Materials

What you'll need

1. R-11 (3½ inch) batt or blanket insulation, glass fiber or rock wool, with a vapor barrier (buy polyethylene if you can't get batts or blankets with a vapor barrier).



2. 2" X 4" studs 

3. Drywall or panelling, if desired. 

4. Waterproof paint, if necessary 

How much

Measure the height and length of the walls you intend to insulate. Multiply these two figures to determine how many square feet of insulation is needed.

(height) X (length) = area
______ X ______ = _______

2. Find the linear feet of studs you'll need by multiplying the length of the walls you intend to insulate by (6).

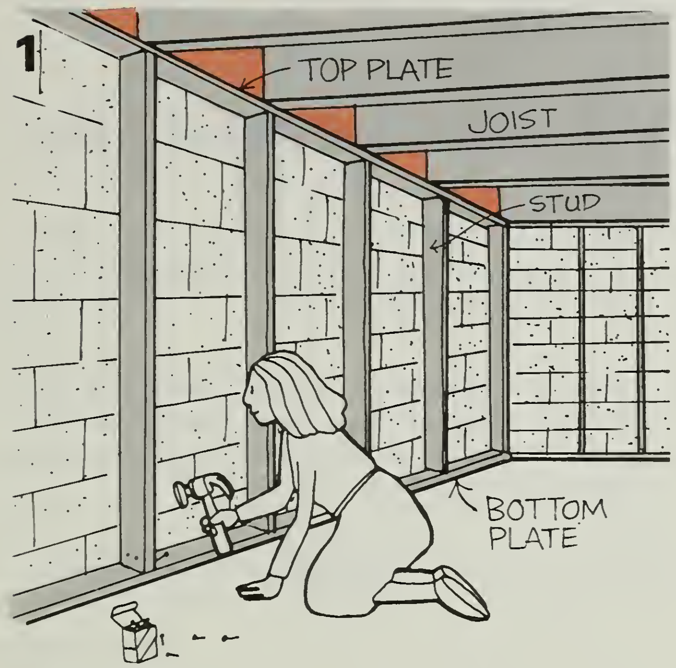
(6) X (length) = (linear ft.)
(6) X ______ = _______

3. The area of wall covering equals the basement wall height times the length of wall you intend to finish.

(height) X (length) = area
______ X ______ = _______

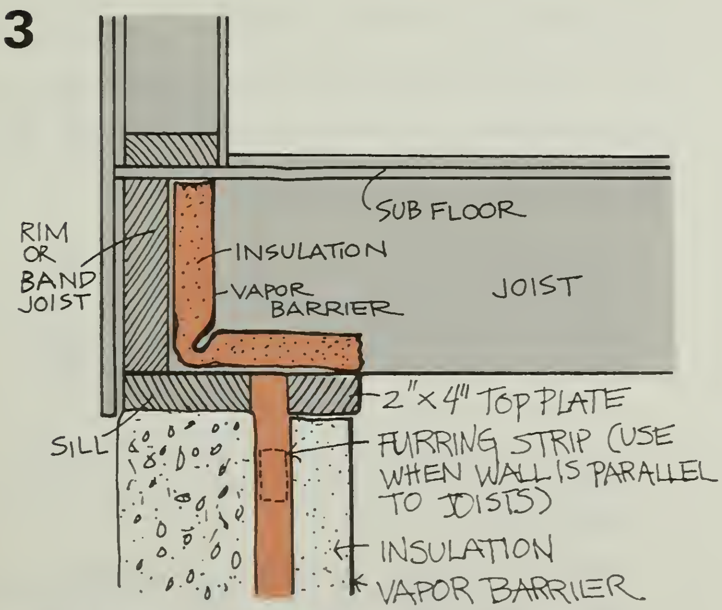
Installation

Check to see whether or not moisture is coming through your basement walls from the ground outside. If it is and your walls are damp, you should eliminate the cause of the dampness to prevent the insulation you're going to install from becoming wet and ineffective. To be sure, install the new studs and insulation slightly away from the wall.

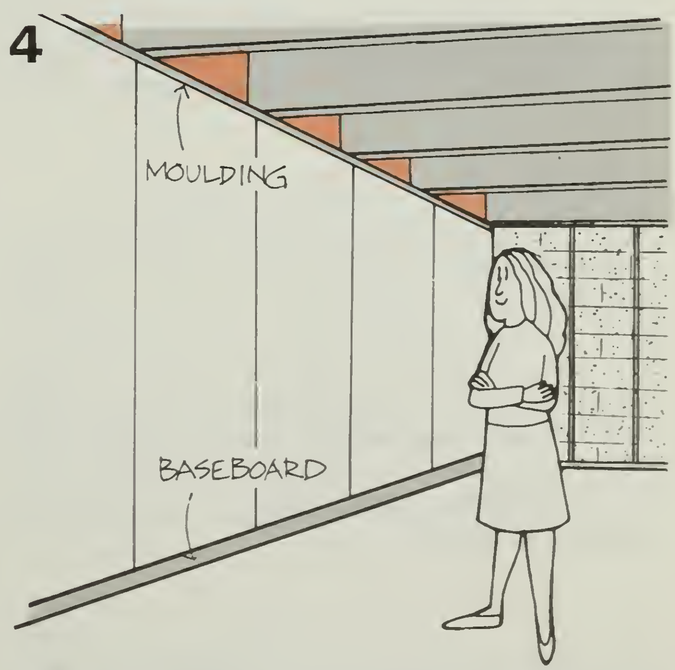


Nail the bottom plate to the floor ¾" out from the base of the wall with a hammer and masonry nails. Install studs 16 or 24 inches apart after the top plate is nailed to the joists above. (Where the wall runs parallel to the joists, you may not be able to fasten the top plate in this way, but may have to fasten a ¾" thick horizontal furring strip to the wall near the top, and fasten the studs to it. Block between studs at ceiling after studs are in place if you need backing for finish wall material.

Cut blankets into sections the height of the wall. Staple them into place, with the vapor barrier toward the living space.

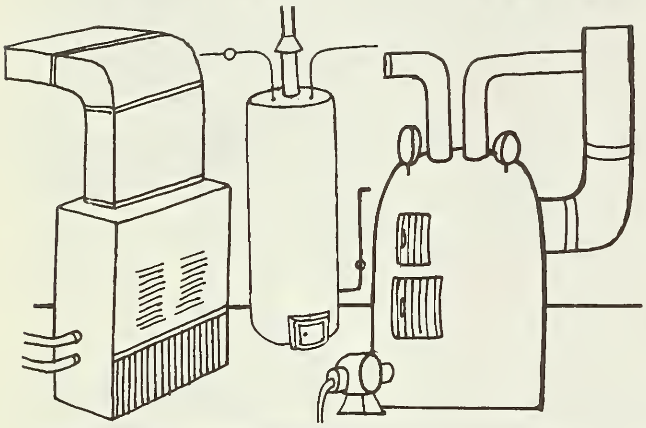


Install another small piece of insulation above the new studs and against the sill to insulate the sill and band joist.



For a more finished look, install finish wall board or panelling over the insulation and studs.

SAVING ENERGY WITH YOUR HEATING, AIR CONDITIONING & WATER HEATING



TWO OPTIONS AVAILABLE

1. **Routine Servicing** – your serviceman should check all your heating and cooling equipment and do any needed maintenance once a year.

2. **Repair or Replacement** – some of your heating and cooling equipment may be so badly worn or outmoded that it will pay you to replace it now and get your money back in a few years.

Routine Servicing

A periodic checkup and maintenance of your heating and cooling equipment can reduce your fuel consumption by about 10 per cent. Locating a good heating/cooling specialist and sticking with him is a good way to ensure that your equipment stays in top fuel-saving condition. Your local fuel supplier or heating/cooling system repair specialist are the people to call – you can find them in the Yellow Pages under:

Heating Contractors	Electric Heating
Air Conditioning Equipment	Oil Burner-Equipment and Service
Furnaces-Heating	

Check out the people you contact with the Better Business Bureau and other homeowners in your area. Once you're satisfied you're in touch with a reputable outfit, a *service contract* is the best arrangement to make. For an annual fee, this gets you a periodic tuneup of your heating/cooling system, and insures you against repairs of most components. A regular arrangement like this is the best one – the serviceman gets to know your system, and you're assured of regular maintenance from a company you know.

In this section, there are lists of items your serviceman should check for each type of heating or cooling system. Some items may vary from brand to brand, but *go over the list with your serviceman.* Also listed here are service items you can probably take care of yourself and save even more money. If you don't want to service your system yourself, *make sure* you add those items to your serviceman's list.

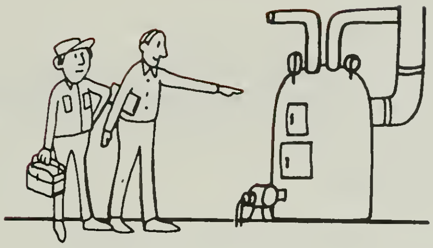
Repair or Replacement

. . . of your equipment may be necessary.

When you are faced with major repairs, inevitably the question comes up: should we fix what we've got, or buy new equipment? It's an important question but not difficult to answer if you consider the right things:

1. Get several estimates – the larger the job the more estimates. The special knowledge of the equipment dealer and installer is most needed here – they'll study your house, measure the walls and windows, and should give you *written* estimates.
2. Check to see what your fuel costs are now. See page 25 to estimate your heating bill if it's mixed in with other utilities.
3. Ask each contractor who gives you an estimate to tell you how many years he thinks it will take before the amount you save by having the new system equals what you paid for it. Remember, fuel costs are going up.

Furnace Maintenance



OIL BURNER

Every Year

Adjust and clean burner unit

Adjust fuel-to-air ratio for maximum efficiency

Check for oil leaks

Check electrical connections, especially on safety devices

Clean heating elements and surfaces

Adjust dampers and draft regulator

Change oil filters

Change air filter

Change oil burner nozzle

Check oil pump

Clean house thermostat contacts and adjust

There are several tests servicemen can use to check oil furnace efficiency:

Draft Test to see if heat is being lost up the chimney or if draft is not enough to properly burn your oil.

Smoke Test to see if your oil is being burned cleanly and completely.

CO_2 test to see if fuel is being burned completely.

Stack Temperature Test to see if stack gases are too hot or not hot enough.

COAL FURNACE

At the end of each heating season

Adjust and clean stoker

Clean burner of all coal, ash and clinkers

Oil the inside of the coal screw and hopper to prevent rust

GAS FURNACE (bottled, LP or natural)

Every 3 Years

Check operation of main gas valve, pressure regulator, and safety control valve

Adjust primary air supply nozzle for proper combustion

Clean thermostat contacts and adjust for proper operation

See Draft Test and Stack Temperature Test above

ELECTRIC FURNACE

Very little maintenance required. Check the manufacturers specifications.

Heat Distribution Systems

Some items here you can do yourself to keep your system at top efficiency. For the ones you can't, check above on how to pick a serviceman. Note: except where it says otherwise, these are all once a year items.

HOT WATER HEATING SYSTEM

Serviceman:

Check pump operation

Check operation of flow control valve

Check for piping leaks

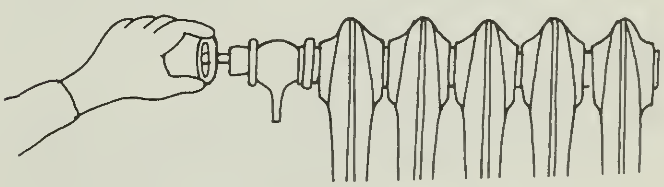
Check operation of radiator valves

Drain and Flush the boiler

Oil Pump Motor

You can do this yourself:

Bleed air from the system. Over time, a certain amount of air will creep into the pipes in your system. It will find its way to the radiators at the top of your house, and wherever there's air, it keeps out hot water. There's usually a small valve at the top of each radiator. *Once or twice a year* open the valve at each radiator. Hold a bucket under it, and keep the valve open until the water comes out. Watch out, the water is *hot.*



Draining and Flushing the boiler is also something you can do yourself. Ask your serviceman to show you how.

FORCED HOT AIR HEATING SYSTEM

Once a Year

Serviceman:

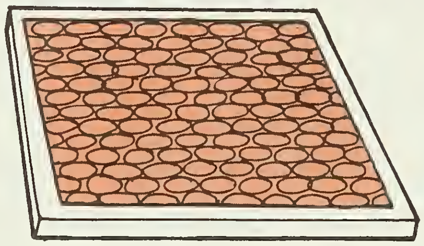
Check blower operation

Oil the blower motor if it doesn't have sealed bearings.

Check for duct leaks where duct is accessible.

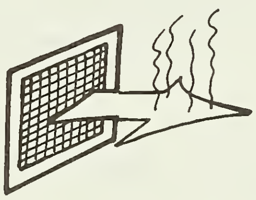
You can do these yourself:

Clean or replace air filters – *this is important,* easy to do, and is something that needs to be done more often than it pays to have a serviceman do it. Every 30 to 60 days during the heating season you should clean or replace (depending on whether they're disposable) the air filters near the furnace in your system. Ask your serviceman how to do it, buy a supply, and stick to a schedule – you can save a lot of fuel this way.



Clean the fan blade that moves the air through your system – it gets dirty easily and won't move the air well unless it's clean. Do this every year.

Keep all registers clean – Vacuum them every few weeks. Warm air coming out of the registers should have a free path unobstructed by curtains or furniture.



STEAM HEAT SYSTEM

With steam heat, if your serviceman checks your burner, (see Furnace Maintenance above) and the water system in your boiler, most of his work is done. There are two things you can do to save energy, though:

Insulate steam pipes that are running through spaces you don't want to heat.

Every 3 weeks during the heating season, drain a bucket of water out of your boiler (your serviceman will show you how) – this keeps sediment off the bottom of the boiler. If the sediment is allowed to stay there, it will actually *insulate* your boiler from the flame in your burner and a lot of heat will go up the chimney that would have heated your home.

Whole-House Air Conditioning

Once a Year

(Got room air conditioners?– many of these hints apply, ask your dealer about what you can do to your room air conditioners)

Serviceman:

Oil bearings on fan and compressor if they are not sealed

Measure electrical current drawn by compressor

Check pulley belt tension

Check for refrigerating fluid leaks and add fluid if needed

Check electrical connections

Re-adjust dampers – if your air conditioner uses the same ducts as your heating system, different settings are usually required for summer cooling than for winter heating.

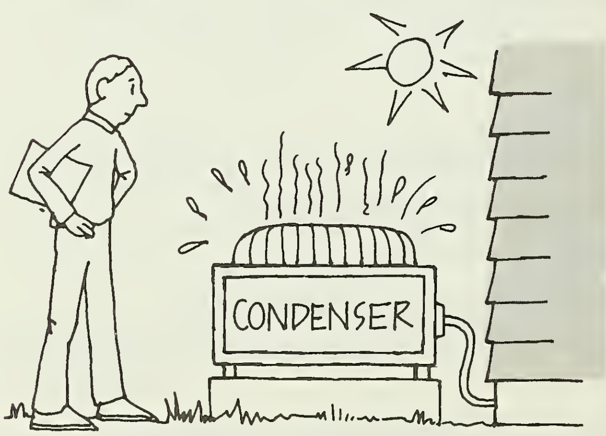
Flush evaporator drain line.

You Can Do These Yourself

Clean or replace air filters – *this is important,* and if done every 30 to 60 days will save you far more money in fuel than the cost of the filters.

Clean the condenser coils of dust, grass clippings, etc.

NOTE: **Your condenser is the part of your air conditioner that sits outside your house. It should be shaded – if it has to work in the sun it wastes a lot of fuel. When you shade it, make sure you don't obstruct the flow of air out and around it.**



Buying a room air conditioner? – see Part 4.

Water Heaters

Once a Year

Serviceman:

Adjust damper (for gas or oil)

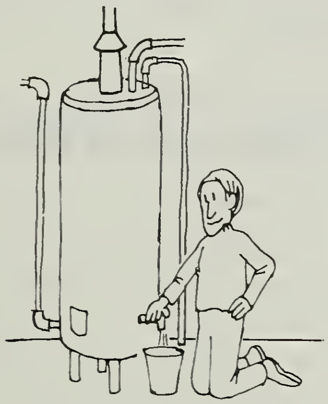
Adjust burner and clean burner surfaces (for oil)

Check electrodes (for electric)

De-lime tank

You can do this yourself:

1. Once or twice a year, drain a bucket of water out of the bottom of the heater tank – this will let out any



sediment that has collected there. The sediment insulates the water in the tank from the burner's flame or electrode – *that* wastes energy.

2. Insulate your water heater tank. This will greatly reduce the amount of fuel the heater uses when you are not using any hot water but when the heater must still keep the water hot. To insulate the heater, use 3" batts or blankets with a paper or foil facing, and duct tape. For a more finished looking job, use duct insulating blankets. There are some water heater insulating kits now being sold at home improvement centers.

Note: With oil or gas heaters, do *not* insulate the top or bottom of the heater. At the top, you may interfere with the draft of the heater's flue. At the bottom, you may cut off air to flame. *Only* insulate the sides.

3. Don't set the temperature of your water heater any higher than you need to – your heater burns fuel keeping your water hot when you're not using it – the higher you set it, the more it burns. If you've got a dishwasher, *140°* is high enough – if not, *120°* is plenty. Depending on the type of fuel you use, this simple setback will save you $5 to $45 a year. (You say your heater says HIGH, MED, LOW? – Call your dealer and ask him which setting means 140 or 120 degrees.) Note: settings over 140° can shorten the life of water heaters, especially those that are glass-lined.

More about hot water conservation – See Part 4.

Duct Insulation

If the ducts for either your heating or your air conditioning system run exposed through your attic or garage (or any other space that is not heated or cooled) they should be insulated. Duct insulation comes generally in blankets 1 or 2" thick. Get the thicker variety, particularly if you've got rectangular ducts. If you're doing this job at all, it's worth it to do it right. For air conditioning ducts, make sure you get the kind of insulation that has a vapor barrier (the vapor barrier goes on the outside). Seal the joints of the insulation tightly with tape to avoid condensation.

NOTE: Check for leaks in the duct and tape them tightly before insulating.

CHOOSING A CONTRACTOR

If you decide that a particular home improvement you want to make should be done by a contractor, there are some things you should know about finding the right person for the job. The large majority of contractors take pride in their business, are conscientious, and honest. But you should still spend some time and effort in making your choice, and once the choice is made, in clearly defining the job.

1. Where to start looking

Yellow Pages under "Insulation Contractors – Cold and Heat." Don't be suspicious of the small operation – even just a carpenter and his helper. You're doing a relatively small project and often the small business man will give you an excellent job.

Local Chapter of the National Association of Home Builders or Home Builders Association. They will be very helpful in recommending contractors.

Your banker. It's in his interest to recommend a man who will do a good job if he's loaning you the money to do the work.

Local government offices for government funded or non-profit operated home improvement assistance centers. They don't exist everywhere but the ones that do are interested in helping, and maintain files on contractors that they recommend.

From these sources, establish a list of three or four contractors from which to select.

2. How to select from your list

Ask each contractor for a list of past customers, and check their satisfaction with his work.

See how long each contractor has been in business – in general, the longer the better.

Call your local Better Business Bureau and ask if there have been any complaints against each of the contractors on your list.

Get estimates from each on any job you think will cost more than $200.00.

3. Once you've selected a contractor – put it IN WRITING

Have him write up a specific contract for your job.

Check the contract carefully for work content and warranty. The best way to do this is to make a list of all the things you feel he should do in the course of the job (use the applicable Part 3 pages for assistance here). Then check what you know should be included against what's in the contract.

Sign the contract only when you are fully satisfied that it details everything you want done. Insisting on a detailed contract doesn't mean that you don't trust your contractor. But once you have a contract, each of you knows his limit of responsibility before the job begins.

GETTING FINANCING

If you don't want to pay for your energy fix-up program out of your savings, and you want to get a much better interest rate than either a loan on your credit card or refinancing your present home mortgage will give you, try one of these:

Where to Get Financing (and Information)	What Kind of Financing	How Long to Repay
Commercial Bank Savings and Loan Mutual Savings Bank	1. Home Improvement Loan	2-5 years
	2. FHA/HUD Title I **NOTE: Lenders are not allowed to charge fees of any kind for this type of loan. Almost all of the improvements mentioned in this manual are eligible under Title I.**	12 years
Your Credit Union	Depends on the Credit Union, but usually includes Title I loans; see above.	Repayment time varies with the type of loan.

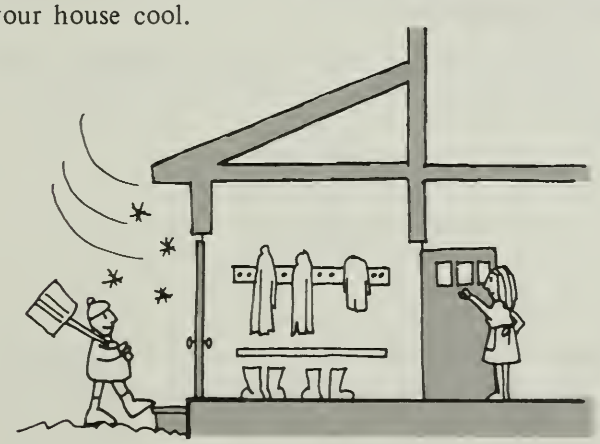
PART 4: MORE..on how to save heating & cooling energy

PART 4: MORE...on how to save heating & cooling energy

Doors and windows

Keep doors and windows firmly shut and locked to cut down heat loss in winter and heat gain in summer. Check your windows and door latches to see whether they fit tightly and, if necessary, adjust the latches and plug any air leaks. You don't really need to open windows in winter – you usually get enough fresh air just from normal air leakage even if your house is well caulked and weatherstripped.

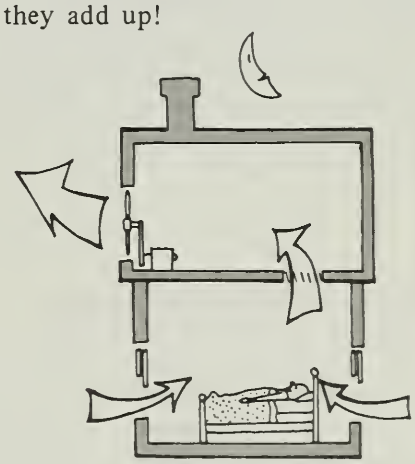
Use heavy or insulated draperies, keep them closed at night, and fit them tightly at the top. In the summer and in warm climates, light colored curtains that you can't see through will reflect the sun and help keep your house cool.



The tightest storm door in the world doesn't work when it's open – try to cut down the number of times that you go in and out. Adding a vestibule at your front and back doors will also help to tighten up your house.

Attic and roof

Seal any openings between your attic and the rest of your house where air might escape, such as spaces around loosely-fitting attic stairway doors or pull-down stairways, penetrations of the ceiling for lights or a fan, and plumbing vents, pipes, or air ducts which pass into the attic – they don't seem like much, but they add up!



One alternative to energy-consuming air conditioning is the use of an *attic fan* to cool your home. Normally a house holds heat, so that there's a lag between the time the outside air cools after sunset on a summer night and the time that the house cools. The purpose of the attic fan is to speed up the cooling of the house by pulling air in through open windows up through the attic and out.

When the fan's on, you can let air through to the attic either by opening the attic door part way or by installing a louver that does the same thing automatically.

In a part of the country that has hot days and cool nights, using an attic fan in the evenings and closing the windows and curtains during the day can *replace* air conditioning. The *size* of the fan you buy should be determined by the amount of space you want to cool. You can figure out the fan size you need by finding the *volume* of your house: Rounding off to the nearest foot, multiply the length of your house by its width, then multiply by its height (from the ground to just below the attic). This will give you the volume in *cubic feet.* The capacity of all fans is marked on the fan in *CFM's* – *C*ubic *F*eet of air moved per *M*inute. Divide the volume of your house by 10; this will give you the CFM rating of the fan you need to change the air in the house 6 times an hour.

____________ ÷ 10 = ____________

volume of house **CFM fan rating**

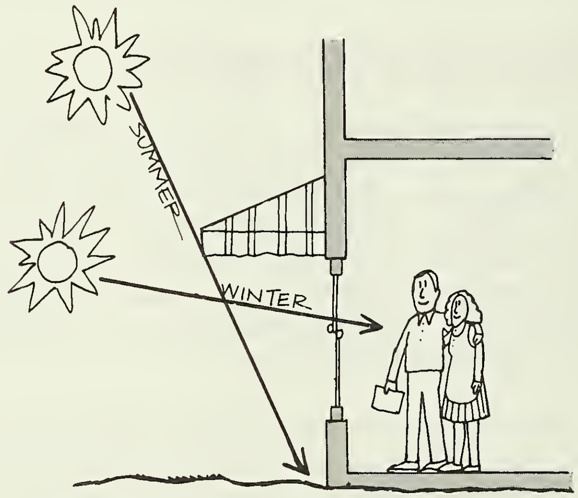
Basements

If you can't afford to insulate the exposed portions of your basement or crawl space for the winter, you can still create some barriers against wind and cold by planting shrubs around the foundation. You can also tarpaper the exposed walls and rake leaves against the foundation, covering them with a weighted tarp (the tarpaper keeps moisture off your house that would otherwise come in through the leaves.)

Shading your home

A good way to keep your house cool in the summer is to shade it from the outside. The east and west sides are where the most heat comes through – if you can shade here, it'll show up right away in a smaller air conditioning bill and a cooler home. Any way that stops the sun before it gets in through the

glass is *seven times* as good at keeping you cool as blinds and curtains on the inside. So trees and vines that shade in the summer and lose their leaves for the winter are what you want – they'll let the sun back in for the winter months. If you can't shade your house with trees, concentrate on keeping the sun out of your windows – awnings, sun shutters, sunshades, or reflective foil will help do the job.



Hot water

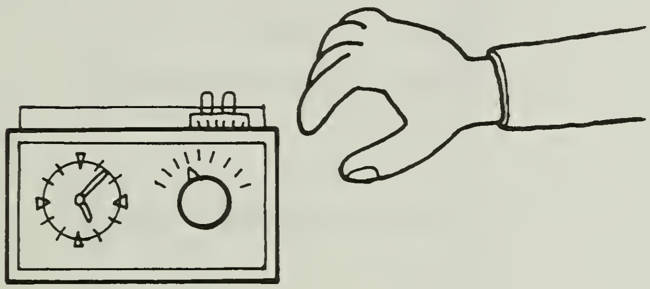
See page 65 for hot water heater maintenance, and turn your heater down to 120° if you haven't already.

All your leaky faucets should be fixed – particularly the hot ones – one leaky faucet can waste up to 6000 gallons of water a year. You can also save by turning your water heater down when you'll be away from home for a weekend or more. Always use full loads in your dishwasher and clothes washer, and use warm wash and cold rinse. Take showers – they use less hot water than baths. You should use cold water to run your garbage disposal – in general, you *save* every time you use cold water instead of hot.

Heating

(See Part 3 for the details on how to keep your system tuned)

In Part 2 (page 25), you can figure out how much you can save by lowering your thermostat. For an extra investment of about $80, you can install a clock thermostat, which will automatically turn your heat down every night and turn it up in the morning. Something that'll do the same job for about $40 is a time-delay thermostat, which is a wind-up timer wired into your thermostat.



More efficient oil burners are available now. If you have oil heating, you can check with your oil company about the new high-speed flame-retention oil burners – they can save you 10% on you oil bill.

Your furnace may be too big. If your house has been insulated since it was built, then your furnace may be too big for your home. In general that means it's inefficient, and would use less fuel overall if it were smaller. Here's how to tell: wait for one of the coldest nights of the year, and set your thermostat at 70°. Once the house temperature reaches 70°, if the furnace burner runs *less* than 40 minutes out of the next hour (time it only when it's running), your furnace is too big. A furnace that's too big turns on and off much more than it should, and that wastes energy. Call your service company – depending on your type of fuel burner, they may be able to cut down the size of your burner without replacing it.

Don't overheat rooms and don't heat or cool rooms you're not using. It's important that no room in your house get more heating than it needs, and that you should be able to turn down the heating or cooling in areas of your home that you don't use. If some of your rooms get too hot before the other rooms are warm enough, you're paying for fuel you don't need, and your system needs *balancing* – call your serviceman. If your house is "zoned," you've got more than one thermostat and can turn down heating or cooling in areas where they're not needed.

But if your house has only one thermostat, you can't properly adjust the temperature in rooms you're not using, and that wastes energy too. You can correct this situation fairly cheaply – try these steps on your system:

Steam Radiators – most valves on radiators are all-on or all-off, but you can buy valves that let you set any temperature you like for that radiator.

Forced-Air Heating or Cooling – Many registers (the place where the air comes out) are adjustable. If not, get ones that are, so you can balance your system.

Hot-water Radiators – if there are valves on your radiators at all, you can use them to adjust the temperature room by room.

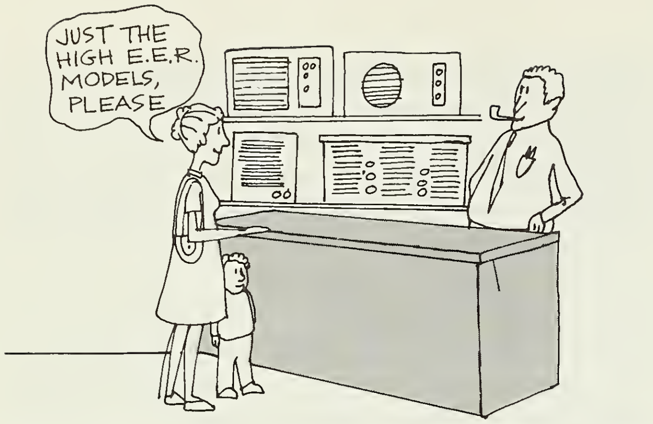
Air conditioning

Controlling your air conditioner's thermostat is discussed in detail in Part 2 (see page 25). Closing off unused rooms is just as important in saving on air conditioning as it is for heating. Keep lights off during the day – most of the electricity they use makes heat, not light. You can also reduce the load on your air conditioning system by not using heat-generating appliances like your dishwasher during the hot part of the day (or stop the dishwasher when the drying cycle begins).

If you have central air conditioning, you may want to look into the *air economizer*, a system which turns off the part of your air conditioner that uses a lot of electricity, and circulates outside air through the house when it's cooler out than it is in. By using the cooler outside air, the system reduces its own job and saves money for you. Ask your air conditioning dealer if he can install one on your system.

Buying a room air conditioner

When you go to buy a room air conditioning unit, check the EER – Energy Efficiency Ratio. The higher the EER number, the less electricity the unit will use to cool the same amount of air – you should consider your possible fuel savings when deciding how much to spend on your air conditioning unit. A unit



which costs more to begin with may save enough money over the next summer to make it worth it.

Typical EER's available range from 4 to 12; a unit with an EER of 4 will cost about **3 times as much** to operate as one with an EER of 12.

The heat pump

A heat pump runs on electricity, and is just like an air conditioner, except it can run in reverse – it can use electricity to heat, and gets more heat out of a dollar's worth of electricity than the resistance heaters in baseboard units and electric furnaces.

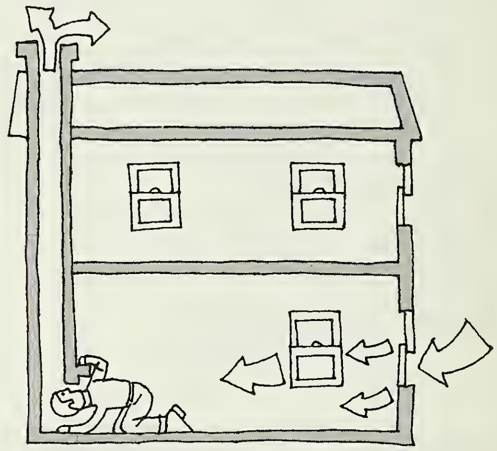
How? – there's heat in the air outside your home, even when the temperature's below freezing, and a heat pump can get that warmth out and into your house. When should you consider installing one? – If you presently have a central electric heating system, it may pay to install a heat pump in the system, next to the furnace. Keep your electric furnace – once the temperature drops below 20° or so, the heat pump will need help from the furnace. Installation of a heat pump large enough for most houses should cost a little under $3000, but you're getting central air conditioning as well as a "furnace" that's more than 2 times as efficient as your electric furnace.

If you're adding a room, consider adding a heat pump – like air conditioners they come in room size units. A heat pump for a room comes with its own electric resistance coil (like a baseboard electric heater) for the times of the year when it's too cold for the heat pump itself to work well. Call your air conditioner dealer for details on both central and room-size heat pumps. If your furnace runs on gas or oil, and the prices of those fuels continue to rise faster than the price of electricity, then you'll want to consider a heat pump too.

Fireplaces

The warm, cozy fireplace is one of the biggest energy wasters there is. Even when it's burning, it pulls more heated air up the chimney than it replaces, and pulls cold air into the house through cracks in the exterior. Even when you're not using your fireplace and you have no damper, or the damper is left open, or if the damper is closed but doesn't fit properly, lots of air you've paid to heat will still go up the chimney.

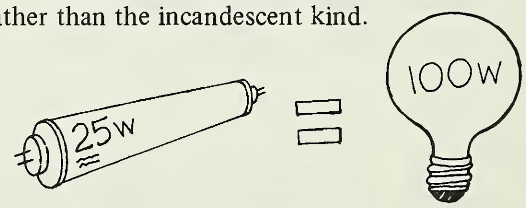
There are many devices on the market that make your fireplace a more efficient wood burner. These range from special andirons to folding glass doors, to wood stoves that replace the fireplace. But unless you live in an area where wood is fairly inexpensive, it almost never pays to invest in these as a replacement for oil, gas, or electricity you now use. All these devices cut the amount of fuel you now waste in a fireplace, but seldom enough to justify their cost, considering that most fireplaces are not used very often.



The most effective ways to cut the amount of fuel your fireplaces waste are free: if you don't use a fireplace, make the flue airtight by making a cover for the front of the fireplace. If you use a fireplace, be sure the damper is closed as soon as the fire is completely out. Normally, an open damper has the same effect on your fuel bill as a hole in the wall twice the size of the damper. A very tall chimney or high winds will increase this effect.

Lights

Plan your lighting sensibly – reduce lighting where possible, concentrating it in work areas or reading areas where it is really needed. Fluorescent bulbs should be used rather than the incandescent kind.



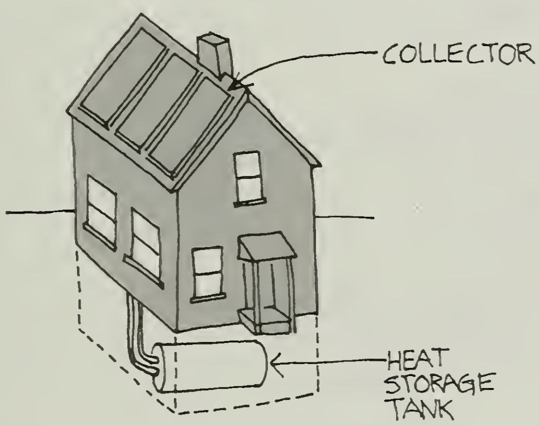
A 25-watt fluorescent bulb gives off as much light as a 100-watt incandescent bulb, but costs one fourth as much to light.

Decorative gas lanterns should be turned off (call your gas company to do this), or converted to electric lamps – they will use much less energy to produce the same amount of light.

...COMING SOON FOR YOUR HOME

Energy from the sun

Ways to use the sun's energy for your home are here *now.* Energy from the sun can be used to heat a home, or to heat domestic hot water. There are two basic ways the sun can be used to heat a home: active and passive. An active system uses a few simple parts: first, a series of large flat panels called *collectors,* that sit on the roof or on the ground next to the house. In the collector, the sun heats up either air or a water-antifreeze mixture that takes the heat into a *storage tank.* If the collector is filled with air, the tank will be filled with rocks or gravel through which the air moves. If the collector is filled with liquid, so is the tank. The tank is then used as a source of heat for the home heating system. What about nights and cloudy days? A solar heating system is never intended to fulfill *all* the heating needs of a house – the storage tank carries enough heat to get through a few overcast days and nights; after that your normal system must carry the load.



A passive system operates on the same principles as an active one, but uses less hardware and relies more on normal parts of the house – south facing windows may be used as collectors, and the heat both stored and distributed by masonry walls or floors. The cost for a solar heating system for an average new house is between $8,000 and $12,000.

Financially, it almost never makes sense to convert an existing home to solar heating or cooling. However, adding a solar unit just to heat your hot water can be a good investment. This is simply a small version of a solar heating system, usually an active one.

Energy from the wind

Windmills that pump water and generate electricity have been around a long time. Recently 2 things are happening that make using a wind generator attractive as a generator for your home: first, windmills and the batteries for the electricity they store are getting more efficient – a modern windmill can grab and hold more electricity out of the same amount of wind. Second, the cost of your monthly electric bill is going up and once a windmill's installed, electricity is nearly free. Like solar heating, a windmill isn't designed to generate *all* your needs – you still need a standard source of electricity – but except for houses with electric heat, a wind generator may produce enough electricity to run your lights and most household appliances.

New ways to get back waste heat

A lot of the fuel you buy to heat your house is wasted – it goes up your chimney, and it goes up your chimney whether your furnace is running or not. There are 2 energy-saving devices coming that can grab that heat before it gets out. (**Note:** if you have electric heat these don't apply. Also, neither of these devices is presently approved for use, but they are coming soon.)

1. **The heatpipe or stack heat exchanger** – both of these are devices that can be installed to sit in the stream of hot flue gases running from your furnace to your chimney. Either device will take heat out of the flue gas, so it can be used in the house. With warm air heating systems, the extra heat can be sent to a warm air duct. So instead of going up the chimney, the heat stays in your house.

2. **The motorized flue damper** – you know that if you leave your fireplace damper open when there's no fire going, a lot of warm air that you've paid to heat goes up the chimney – this same thing happens with your furnace when it's not running. A motorized flue damper works just like the one in your fireplace, except it's automatic – when the furnace is running, the damper's open, and the instant the furnace shuts off the damper closes.

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Acknowledgements

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The authors wish to thank Mr. Robert C. Jones, Jr. AIA, from the Division of Energy, Building Technology and Standards at HUD, for his untiring professional assistance and support. His concern that this manual be a useful and convenient tool for homeowners has guided us throughout the course of this project.

This manual was originally reviewed by an Advisory Committee of the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE) for general consistency with current good practice for modification of existing housing to reduce energy use. At review meetings and informal discussions, valuable constructive dialogue between the members of the Committee and the authors has greatly assisted in the resolution of many of the technical issues dealt with in this manual. The members of the Review Committee were:

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Disclaimer

DIRECTIONS

THESE ARE THE TWO PAGES THAT PUT IT ALL TOGETHER. YOU ALREADY KNOW FROM PART 2 WHICH OF THESE LINES YOU WANT TO COMPLETE. HERE'S HOW TO FINISH THEM.

How to fill in lines 1-5:

First, use Part 2 to fill in the Cost and Savings Factor for each line you're interested in.

Lines 2 and 4:

Get your Heating Factor from page 28 and fill it into the oval (◯) on lines 2 and 4. Find your yearly dollar savings like this:

MULTIPLY THESE			WRITE THE RESULT HERE
Heating Factor		Savings Factor	Yearly Savings
◯	x	☐	= $ ________

Lines 1,3, and 5:

Get your Heating Factor from page 28 and fill it into the Heating Factor oval (◯).

If you **do** have whole-house air conditioning, get your Cooling Factor from page 28 and fill it into the oval (◯).

If you **don't** have whole-house air conditioning, put zeros into the Cooling Factor oval, like this: (◯).

Get your yearly dollar savings like this:

ADD THESE		WRITE THE SUM HERE	MULTIPLY THESE	WRITE THE RESULT HERE
Heating Factor	Cooling Factor		Savings Factor	Yearly Savings
◯ +	◯	= ____ x	☐	= $ ________

How to fill in lines 6,7, and 8:

Just copy your yearly savings from pages 25, 26, and 27 into the appropriate boxes on the checklist.

WHAT ARE YOUR BEST INVESTMENTS?

There are two kinds of investments here – the kind you have to make each year, and the kind you only have to make once. Here's how to directly compare the two different kinds of investments and figure out which are your best bets:

For the investments that you have to make each year (lines 2a, 2b, 7, and 8), use this method: simply subtract the yearly cost from the yearly savings, and write the difference in the right-hand box on the line of the checklist dealing with the measure. This number is the net savings per year for the investment.

________ – ________ = ________
savings **cost** **net savings**

For "one-shot" investments that you only have to pay for once (lines 1, 2c, 3-5), multiply the yearly savings by 13, subtract the cost from the result, and write the difference in the right-hand box on the line of the checklist dealing with the measure. This number is the net savings over the life of the investment.

________ – ________ = ________
(savings x 13*) **cost** **net savings**

***Multiplying your estimated savings in the first year by 13 projects the savings (in terms of today's money) that a "one-shot" energy-saving improvement will deliver to you over its life. The figure 13 takes into account the rate of inflation, and assumes that you can borrow money at the average available interest rate.**

HOW TO INTERPRET THE CHECKLIST

Now you're ready to figure out what are the best energy-savings steps for you.

First – look at the cost figures. Don't consider doing things you can't afford. But be sure you don't leave out things you **can** afford – read page 66, which tells you how to finance home improvements.

Second – for the measures you can afford, look at the net savings in the right-hand column. The things to do first are the things that have the highest net savings. Do the measures with the highest net savings, then the next highest, and so on – until you've done all you can afford. Don't do a measure if the net savings are less than 0.

Now you're ready to go on to part 3 – the "How-to" part. It starts on page 33.

U.S. GOVERNMENT PRINTING OFFICE : 1977 O—247-839

ENERGY CHECKLIST

	SAVINGS FACTOR FROM PART 2	YEARLY SAVINGS	COST FROM PART 2	NET SAVINGS
CAULK AND WEATHERSTRIP Heating factor ( ) + Cooling factor ( ) = ____ ×	Savings factor [ ] =	$ ____	Total cost $	
2. ADD STORM WINDOWS				
a) plastic storm windows (with no new weatherstripping) Heating factor ( ) ×	Savings factor [ ] =	$ ____	Yearly cost $	
b) plastic storm windows (with new weatherstripping — be sure to fill out line 1 above) Heating factor ( ) ×	Savings factor [ ] =	$ ____	Yearly cost $	
c) glass or rigid plastic storm windows (with new weatherstripping — be sure to fill out line 1 above) Heating factor ( ) ×	Savings factor [ ] =	$ ____	Total cost $	
3. INSULATE ATTIC Fill out both lines if your attic is a combination of two basic attic types (see page 11). Otherwise, fill out the top line only.				
Heating factor ( ) + Cooling factor ( ) = ____ ×	Savings factor [ ] =	$ ____	Total cost $	
Heating factor ( ) + Cooling factor ( ) = ____ ×	Savings factor [ ] =	$ ____	Total cost $	
4. INSULATE CRAWL SPACE WALLS, FLOOR, OR BASEMENT WALLS				
a) Insulate crawl space walls Heating factor ( ) ×	Savings factor [ ] =	$ ____	Total cost $	
b) Insulate floor Heating factor ( ) ×	Savings factor [ ] =	$ ____	Total cost $	
c) Insulate basement walls Heating factor ( ) ×	Savings factor [ ] =	$ ____	Total cost $	
5. INSULATE FRAME WALLS Heating factor ( ) + Cooling factor ( ) = ____ ×	Savings factor [ ] =	$ ____	Total cost $	
6. REGULATE THERMOSTAT Down in winter, up in summer.	Degrees turndown [ ]	From Part 2 $	Yearly cost $ 0	
7. SERVICE OIL OR COAL-BURNING FURNACE		From Part 2 $	Yearly cost $ 30-35	
8. SERVICE WHOLE-HOUSE AIR CONDITIONER		From Part 2 $	Yearly cost $ 30-35	

October 1977
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Cooperative Extension Service

UNIVERSITY OF ARKANSAS Division of Agriculture, U. S. Department of Agriculture and County Governments Cooperating

ENERGY $

LAUNDRY TECHNIQUES TO SAVE ENERGY

Elizabeth Ellis
Extension Specialist - Household Equipment

W. Jeanette Roberts
Extension Clothing Specialist

Energy cost and energy conservation are of growing concern. One area where energy conservation is possible is in home laundries where about 80 percent of all family wash is done. Home laundering requires energy for water heating, washing, and drying. Many factors—such as water temperature, detergents and cleaning agents, different fabrics and finishes, and overall laundering practices—are involved.

This information sheet provides suggestions for efficient laundering while conserving energy and reducing utility bills.

WATER TEMPERATURE

The biggest share of energy used for washing clothes—about 85 percent—is for heating water. Your washer can run about 50 cycles on the energy needed to heat water for just one hot-water wash. The general rule still holds true that the hotter the water, the cleaner the clothes and the colder the water, the more difficult the cleaning job. However, hot, warm, and cold water all have a place in energy-conserving laundering.

Hot-wash and warm-rinse, which uses about 25 gallons of hot water and 9 gallons of cold water in a large capacity washer, is not always necessary. Studies have shown that the average washing temperature is between 125° - 135°F. You can reduce energy consumption about 50 percent by using warm water for washing and cold water for rinsing. And you can save even more if you wash and rinse some laundry loads in cold water.

In terms of best results, the most important factors in selecting water temperature are type and color of fabric and type and amount of soil. Here are some recommended guidelines:

Use hot (130°F. or warmer) for:

- 100 percent white and colorfast cottons.
- Heavily soiled white or light-colored cottons.
- Greasy, oily stains which generally need hot water to melt and remove fats.
- Perspiration and deodorant stains.
- Diapers.

Use warm (100°-110°F.) for:

- Man-made fabrics, knits or wovens, permanent press or wash and wear, all of which require less pressing with warm wash and cold rinse.

Use cold (80°F. or cooler) for:

- All rinsing. You can use cold water for all rinsing, regardless of washwater temperature.
- Washable woolens.
- Bright or intense colors, unless heavily soiled.
- Dark or bright colors that bleed.
- Stains such as blood, fruit juices, and milk.
- Moderately to heavily soiled items that have been presoaked and/or pretreated.

WASHING

A washing machine is a major appliance in modern households. In fact, 95 percent of our nation's households have washing machines. A typical home washer is designed to wash, rinse, and extract water from the clothes without attention.

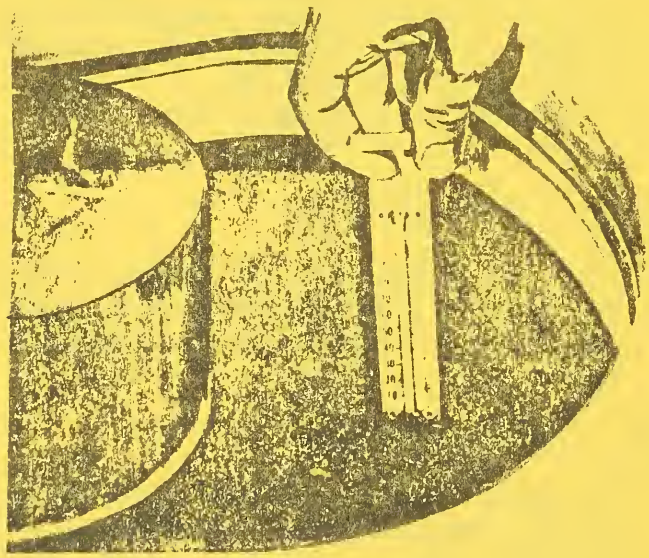
But the dial settings and other laundry techniques are crucial for it to do an effective job without wasting energy. Good laundering practices are always important regardless of water temperature, but they become especially important for cold-water washing where the removal of soil is somewhat more difficult to accomplish.

The nature of each individual washload is unique. Conserve energy by doing it right the first time. If washing results are not acceptable and clothes have to be rewashed, energy is wasted.

Extra Steps for Cold Wash

IMPORTANT: If you are cold-water washing, extra steps may be needed for satisfactory results. Follow these tips:

1. Measure the cold-water temperature using a candy or cooking thermometer. For best results, cold water should be 60°F. or warmer, preferably 70°F. Temperatures below 50°F. are generally too cold to give good washing results for modern fabrics with today's detergents. Remember, cold tap water temperatures change with the seasons and vary according to location.



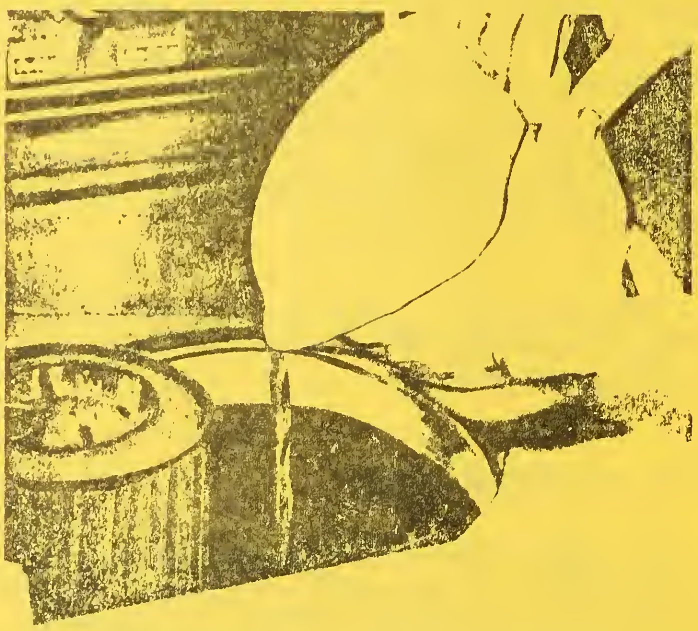
Cold water below 50°F. will do little cleaning.

2. Use a water softener if your water is hard, if it is medium to hard, and if you use a nonphosphate detergent. In the United States, 85 of every 100 homes are in hard water areas. Although soft water means cleaner washes regardless of water temperature, soft water is especially helpful when using cold water.

3. Pretreat spots, stains and heavy or greasy soils with your liquid detergent, powdered-detergent paste, or a laundry pretreating aid. Pretreating sprays, spot removers, and grease solvents are needed as substitutes for hot water, which is generally used for oily soil removal.

4. Use more detergent. The exact quantity of detergent you use will depend on water hardness, type of detergent, amount of soil, and size of the load. However, as a general rule for cold water wash, use 1½ times the usual amount of detergent.

5. Dissolve powdered detergents in warm water before adding them to cold water in the washer, since some powdered detergents tend to clump and do not dissolve well in cold water. Do this even when your product is designed for cold water.



Dissolve powdered detergent in warm water before adding it to cold water.

6. Fill your washer with cold water, add the detergent in liquid form, then agitate a few minutes before adding clothes.

7. Wash longer. Select the longest cycle on your washer or add agitation time to a short cycle. For best soil removal, agitate the washload for not more than 12 minutes, or use a prewash or presoak to give extra washing action.

8. Alternate the use of cold-water and warm-water wash if garments become dingy. A greyed look after a number of cold-water washings means that soil has not been completely removed. An occasional warm- or hot-water wash with plenty of detergent will restore whiteness and brightness.

Sorting

Careful sorting of clothes is essential for clean, lint-free wash. Sort your laundry according to color, fabric, garment construction, amount and kind of soil, and size of item.

Sort your laundry according to color, amount of soil, fabric type, and tendency to lint.

Wash lightly soiled whites separately. If they are washed with heavily soiled whites or colors, they may look worse after washing than before washing. Restoring these items to whiteness takes more water, detergent, time, and energy than if they had been washed separately in the first place.

Some fabrics attract lint while others just as easily give up lint. Therefore, both lint-givers (terry cloth) and lint-catchers (nap textures used in socks) should be washed in separate washloads.

Disinfecting

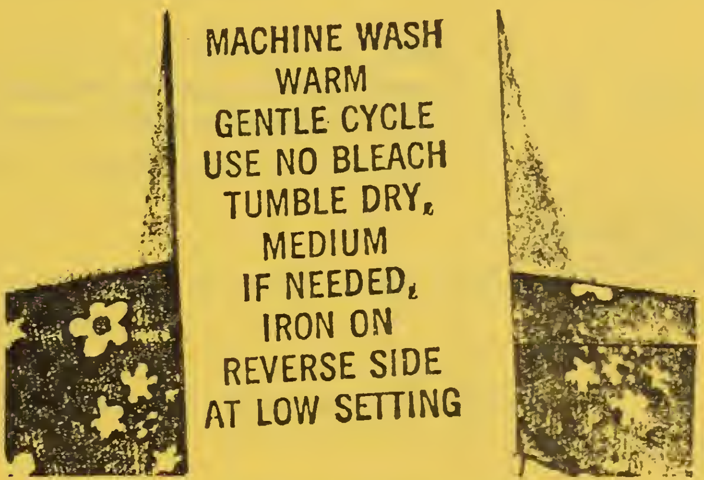
Unless it is well over 140°F., water temperature has little effect on disinfecting your laundry. Except when there is a serious illness in your house, laundry disinfection isn't necessary. When you wish to disinfect, use bleach for bleachable items and pine oil or phenolic disinfectants for nonbleachables.

You can safely use bleach for 75 percent of all colored garments. Liquid bleach is effective in cold water, while all fabric bleach diminishes in effectiveness from hot to warm to cold water.

Reading Labels

By law, your clothes must be identified for fiber content and have Permanent Care Labels, which give you instructions for proper care. You may have noticed that hot water is rarely recommended for today's fabrics and finishes, since man-made fibers are heat sensitive. For best laundering results, read and follow care labeling faithfully. This will also help prolong the life of your clothing.

Carefully reading and following directions on your detergents and cleaning agents is also very important for the best results as well as for energy conservation.



Read and follow Permanent Care Label instructions.

More Ways to Save Washing Energy

— Have the washer close to the water heater since the water will cool as it travels through the pipes. Generally, the temperature will drop about 1° per foot of pipe.

— Wash when power usage is low—after 8 p.m.

— Use the short wash cycle for lightly soiled garments.

— Wash full loads whenever possible. If you must wash a smaller load, be sure to set your water level accordingly.

DRYING

Your dryer also is a major user of electricity in the home. Here are a few reminders for conserving energy while drying your laundry:

— Wash and dry several loads in succession. A warm dryer uses less energy since metal parts do not have to be heated each time.

— Separate dryer loads into light and heavy weight fabrics for shortest drying time.

— Be sure to select the correct setting, according to the type of fabric and the directions in your dryer's instruction manual.

— Avoid over-drying, which wastes energy and causes static electricity and wrinkling. Except for 100 percent cottons, clothes should be removed when they still have a little moisture in them.

— Dry only full loads; but don't overload your machine.

— Drip-dry individual items and very small loads in your bathroom or on your porch rather than run the dryer.

— Keep the dryer lint screen clean for fastest drying.

— Remember the fresh, clean smell of a line-dried wash? Let your dryer rest whenever possible by line drying your wash. A good way to save energy is to use your dryer only in inclement weather. Careful hanging will help reduce wrinkling.

Source: Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Florida 32611.

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Cooperative Extension Service
University of Arkansas Division of Agriculture, U. S. Department of Agriculture, and County Governments Cooperating

ENERGY $

HOUSEHOLD APPLIANCES — OPERATION COSTS

Elizabeth Ellis
Extension Specialist - Household Equipment

To retain some semblance of the level of living we have been used to for many years, each one of us needs to learn to conserve energy. In order to do this, we need to know which appliances to use, to what extent these appliances can be used, and yet save the greatest amount of energy.

Even though only 19.2 percent of the energy is used in the home, we can still conserve energy and save money.

There are certain generalizations that we can draw from the chart that will be included in this information.

1. Any heating appliance uses more energy than a motor-driven appliance.

2. Any time a heating appliance is used, use the smallest type that can be used to do that job so less energy will be consumed. An electric toaster uses less energy to toast bread than a regular conventional oven.

Included is a list of appliances prepared by the Electric Energy Association, Gas Appliance Manufacturers Association, American Gas Association, and Merchandising Week Research Department.

I am sure you will be wondering about appliances that are not included in this list. May I suggest that you look at the faceplate, usually located at the back or underneath the appliance, which gives you the amount of watts this appliance consumes. Remember, for example, the average frypan uses 1,196 watts. This means that if the frypan is left on for one hour and does not cycle on and off, this is the amount of electricity that it will use in one hour.

To figure how much wattage a frypan would use through an entire year, multiply the average wattage times the number of times it will be used during a 12-month period.

To mention a few of the significant items that are included in the list, a 15 cubic foot freezer averages 1,195 kilowatt hours per year compared to a 15 cubic foot frostless freezer, which uses 1,761 kilowatt hours per year. Then look at the refrigerator/freezer. This is where the refrigerator is automatically defrosted and the freezer is manually defrosted. A 14 cubic foot refrigerator consumes 1,137 kilowatt hours per year as compared to the same size in the frostless type, which consumes 1,829 kilowatt hours per year.

This indicates that the frostless freezer and/or refrigerator/freezer combination consumes more energy than either the automatic or manual defrost box.

If we do not consider anything other than the consumption of energy, compare the gas range, which uses 105 therms annually at a cost of approximately $12.45, with an electric range which uses approximately 1,175 kilowatt hours at a cost of $24.67.

I hope that you will be able to use this information and assist the people with whom you work in analyzing which appliances would be most efficient in the conservation of energy.

	Average Wattage	Estimated Kilowatt Hours Consumed Annually	1973 .021¢ per KWH	1977 .04¢ per KWH
Food Preservation				
Freezer (15 cu. ft.)	341	1,195	25.09	47.80
Freezer (frostless 15 cu. ft.)	440	1,761	36.98	70.44
Refrigerator (12 cu. ft.)	241	728	15.28	29.12
Refrigerator (frostless 12 cu. ft.)	321	1,217	25.55	48.68
Refrigerator/freezer (14 cu. ft.)	326	1,137	23.87	45.48
Refrigerator/freezer (frostless 14 cu. ft.)	615	1,829	38.40	73.16

Food Preparation			1973	1977
Blender	386	15	.31	.60
Boiler	1,436	100	2.10	4.00
Carving knife	92	8	.16	.32
Coffeemaker	894	106	2.22	4.24
Deepfryer	1,488	83	1.74	3.32
Dishwasher	1,201	363	7.62	14.52
Egg cooker	516	14	.29	.56
Frying pan	1,196	186	3.90	7.44
Hot plate	1,257	90	1.89	3.60
Mixer (hand)	127	13	.27	.52
Oven, microwave	1,500	300	6.30	12.00
Oven, self-cleaning	4,800	1,146	24.06	45.84
Range	8,200	1,175	24.67	47.00
Roaster	1,333	205	4.30	8.20
Sandwich grill	1,161	33	.69	1.32
Toaster	1,146	39	.81	1.56
Trash compactor	400	60	1.26	2.40
Waffle iron	1,116	22	.46	.88
Waste disposer	445	30	.63	1.20
Can opener		10	.21	.40
Comfort Conditioning				
Air cleaner	50	216	4.53	8.64
Air conditioner (room)	1,566	1,389	29.16	55.56
Bedcovering	177	147	3.08	5.88
Dehumidifer	257	377	7.91	15.08
Fan (attic)	370	291	6.11	11.64
Fan (circulating)	88	43	.90	1.72
Fan (rollaway)	171	138	2.89	5.52
Fan (window)	200	170	3.57	6.80
Heater (portable)	1,322	176	3.69	7.04
Heating pad	65	10	.21	.40
Humidifier	177	163	3.42	6.52
Health and Beauty				
Germicidal lamp	20	141	2.96	5.64
Hair dryer	381	14	.29	.56
Heat lamp (infrared)	250	13	.27	.52
Shaver	14	1.8	.03	.07
Sunlamp	279	16	.34	.64
Toothbrush	7	0.5	.01	.02
Vibrator	40	2	.04	.08

Laundry			1973	1977
Clothes dryer (electric)	4,856	993	20.85	39.72
Iron (hand)	1,008	144	3.02	5.76
Washing machine (auto.)	512	103	2.16	4.12
Water heater (standard)	2,475	4,219	88.59	168.76
Water heater (quick recovery)	4,474	4,811	101.03	192.44
Home Entertainment				
Radio	71	86	1.80	3.44
Radio-record player	109	109	2.28	4.36
T.V. B/W tube	160	350	7.35	14.00
T.V. B/W solid state	55	120	2.52	4.80
T.V. color tube	300	660	13.86	26.40
T.V. color solid state	200	440	9.24	17.60
Housewares				
Clock	2	17	.35	.68
Floor polisher	305	15	.32	.60
Sewing machine	75	11	.23	.44
Vacuum cleaner	630	47	.98	1.88

1,000 watts equal 1 kilowatt hour.
100-watt bulb burning 10 hours equal 1 kilowatt hour.

Gas Appliances	Annual Therms	Annual Cost 10.4¢ per Therm (Natural gas)	Annual Cost 15¢ per Therm (Natural gas)
Range (residential)	105	10.92	15.75
Range (apartment)	88	9.15	13.20
Dryer (gas pilot)	75	7.80	11.25
Dryer (electric pilot)	60	6.24	9.00
Water heater (30 gal.)	360	37.44	54.00

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EXTENSION
ENERGY CONSERVATION

COOPERATIVE EXTENSION SERVICE/UNIVERSITY OF GEORGIA COLLEGE OF AGRICULTURE/ATHENS

Conserving Hot Water In Your Home

Heating Water

Hot baths, clean clothes and spotless dishes are taken for granted. Georgians want hot water on demand, but they may not realize how much energy is required to provide it.

Heating water may account for 15 to 25 percent of a household's total energy consumption. But, with a little initiative, you can save water, energy and money with only a minimum of effort and expense.

Maintaining the Water Heater

You can increase the efficiency of your water heater by draining water out of it from time to time; a faucet in the bottom is provided for this purpose. Hard water can form a mineral deposit on the inside of the tank, and this buildup can cause energy loss and tank deterioration. When heated, soft water causes metal to rust. Unless the water heater is lined with a non-rusting material, the mineral buildup can cause rust on clothes and dishes, in kitchen and on bathroom equipment, and may result in decreased water heater storage capacity.

Need a New Water Heater?

Buy the right size. An oversized water heater requires extra energy to start heating water and more to keep it hot. An appliance that is too small has to work harder to heat water that may be inadequate for household needs.

Ask your gas or electric utility company for help in choosing the proper water heater.

Make your water heater more efficient by locating it as close as possible to the kitchen, bath, and laundry. To reduce both heat loss and the volume of trapped water, use small diameter pipes. Wrapping the hot water pipes with insulation will also cut heat loss.

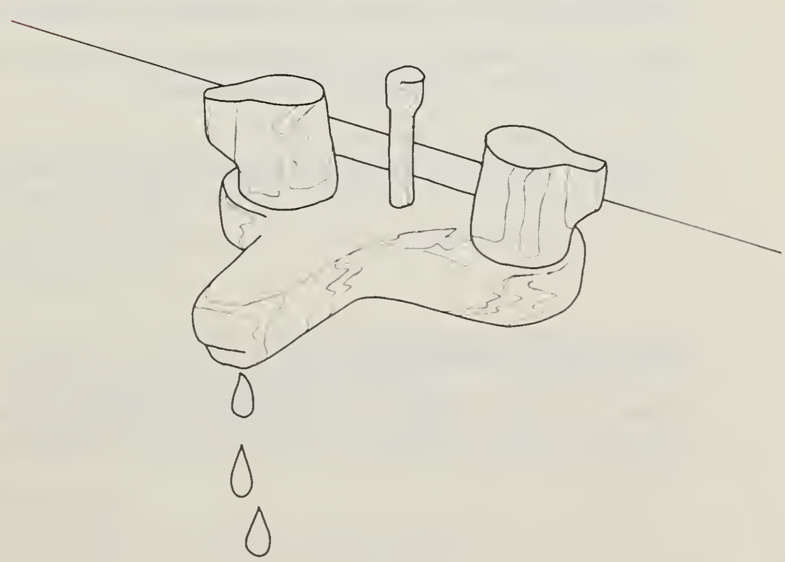
Hot Water Conservation Hints

. . . in the bathroom

* Reach for the cold water faucet when you don't need hot water, and don't wait for the water to run hot.
* A quick shower uses less water than a tub bath.
* Combine showering and shampooing.
* Consider installing a hand-held shower head for shampooing. It is easy to use and can be turned off while you wash and on when you rinse. Or purchase a flow restrictor for the shower which reduces water flow from five gallons per minute to three gallons without reducing pressure.
* Don't let the water run continuously while you're shaving.

. . . in the kitchen

* Dripping hot water faucets waste enormous amounts of energy. One drop per second can mean an annual loss of 2400 gallons of hot water -- enough to wash 150 loads of dishes.



* When washing dishes by hand, use a pan or sink bowl of water for rinsing instead of a running stream.
* Run your dishwasher only when it is full.
* Use cold water at the sink whenever possible.
* Dishwashers and white clothes require a water temperature of 140° - 160° for effective cleaning. If you do not have a dishwasher or have one that has a built-in booster heater for the water, you may be able to set the water heater thermostat a little lower than 140°.

. . . **in the laundry**

* Fit the washer water level to the size of the clothes load.

* Use cold water for all rinsing. Use hot wash water for white and colorfast cottons, heavily soiled or greasy work clothes and baby's diapers. Use warm wash for other loads.

* Pre-soak heavily soiled clothes before laundering. Pretreat spots and stains on all articles.

Compiled by Doris Oglesby, Extension Home Economist, and Cecil Hammond, Extension Engineer.

Grateful appreciation is expressed to the Georgia Department of Energy Resources for contributions made toward the printing of this material.

H & E 1-2

Miscellaneous Publication 57 March, 1978

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Tal C. DuVall, Director

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Cooperative Extension Service

UNIVERSITY OF ARKANSAS Division of Agriculture, U. S. Department of Agriculture and County Governments Cooperating

ENERGY $

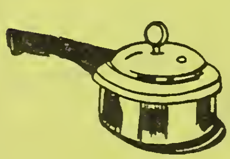
Conserving Energy When You Cook!

When cooking on top of the range, use utensils with flat bottoms and tight fitting covers. The utensil should also be the same size as the surface unit or burner.

Start cooking on high heat and then reduce to the lowest possible setting to continue cooking. Turn off heat source as soon as, or before, the food is cooked.

When cooking vegetables and some other foods, use a small amount of water. It takes less time to bring it to a boil. In addition, there may be loss of nutrients.

Cook foods the shortest possible length of time. This may also conserve food value.



Check the color of the flame when using gas. A blue flame means efficient heat consumption; a yellow flame indicates poor consumption.

Reduce cooking time by using double boilers, pressure saucepans and pan dividers to cook several foods at a time for a shorter period of time.

When preparing certain foods which require longer cooking times, such as stews, soups, and chili, plan to cook enough for more than one meal. Cool rapidly and freeze the extra.

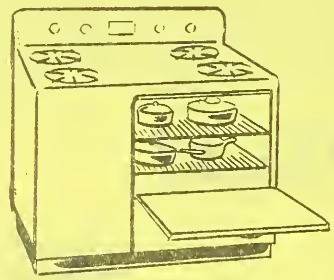
Cool cooked foods as rapidly as possible by placing pan in cold water and stirring occasionally before refrigerating or freezing.

Avoid using the range to heat the kitchen or to heat large quantities of water. Space heaters and water heaters are more efficient.

If available, use a microwave oven. Regular ovens require more power for a longer period of time and account for five to seven percent of the energy bill.

Keep oven vents clean and open to allow even and efficient circulation of heat.

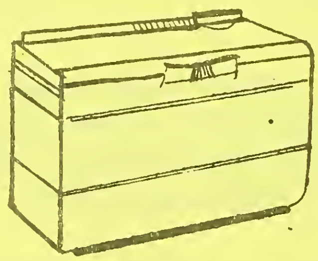
Plan to use the oven for complete meals or several meals. Prepare foods in time sequence so that the same fuel cooks several dishes.



Open the oven door only when necessary during cooking time.

Avoid using the oven for small jobs such as making toast.

Get foods into the oven as soon as the oven is preheated. Some foods do not need preheated ovens. Arrange racks and pans for even heating; center whatever you are baking, and divide the oven in thirds by using racks.



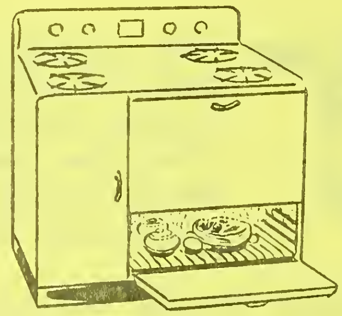
When baking breads, desserts, and other foods, plan to bake extra food and freeze for later use.

Using trial and error, you may find that you can turn the oven off shortly before the food has finished cooking.

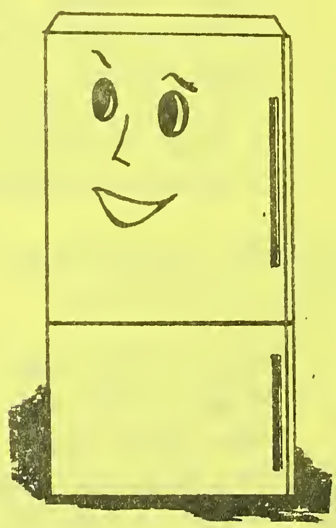
Place a piece of foil, slightly larger than the pan, on a lower rack to catch drips. This protects the oven and prevents reflection of some of the heat away from the pan. Do not put foil on the bottom of the oven. It may interfere with heat circulation.

Avoid using the cleaning feature on self-cleaning ovens at times when air conditioning loads are heavy. Avoid spill-overs whenever possible. Cut down on the need for cleaning.

Plan to use the broiler to cook more than one food at a time. Vegetables in the broiler pan will be seasoned and heated while meat is cooking on the rack.



If you cook on an outdoor gas grill, turn off the pilot light on the grill between uses.



Refrigerate foods in several smaller containers rather than one large one. Foods will cool more rapidly and use less power.

Save Money and Energy

Mrs. Francille K. Johnson
Extension Food and Nutrition Specialist

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Cooperative Extension Service

UNIVERSITY OF ARKANSAS Division of Agriculture, U. S. Department of Agriculture and County Governments Cooperating

ENERGY $

ENERGY EFFICIENCY AT MEALTIME

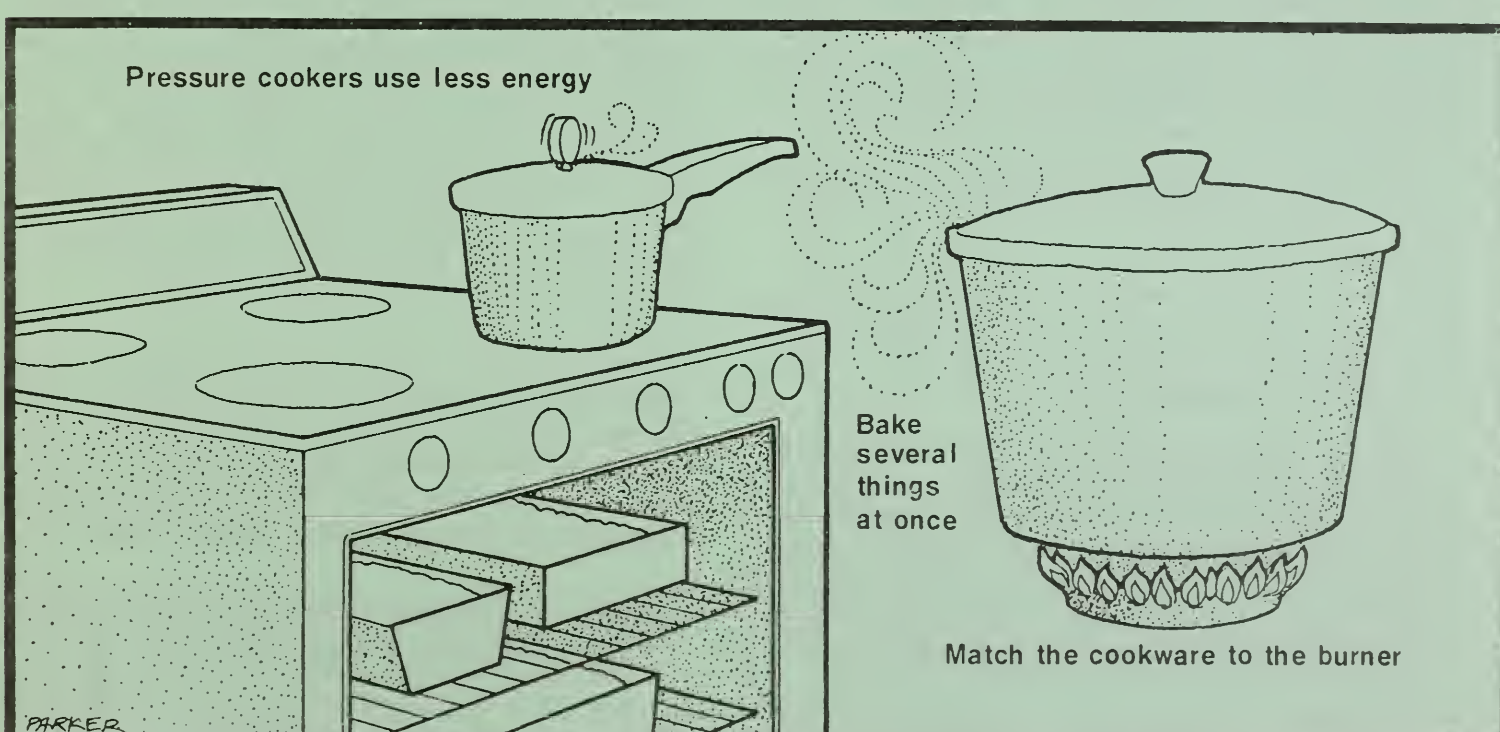
Elizabeth Ellis
Extension Specialist - Household Equipment
and
Mrs. Francille K. Johnson
Extension Food and Nutrition Specialist

Meal planning entails selecting menus for a week or more and making an accompanying food shopping list. The conscientious meal planner adds another step: planning for efficient use of energy. To take full advantage of kitchen appliances, and at the same time save energy, make optimum use of appliance design features.

TOP-OF-RANGE COOKING

The efficiency of a surface unit or burner depends on the utensil as well as the range. For better use of energy, match the shape and size of a cooking utensil to the task. Cookware with flat bottoms allows efficient heat transfer. The pan should be thick enough to resist denting and warping. Match the pan to the unit or burner. The bottom of the utensil should not extend more than one inch beyond the outer ring of the surface unit; similarly, the flame or coil should not extend beyond the pan. Turn the heat down when the food reaches the cooking temperature and use the lowest possible heat level to complete the cooking process.

Aluminum is frequently used for cooking utensils. Both aluminum and copper are good conductors of heat and spread the heat evenly in



the utensil; stainless steel is not as good a conductor. For improved spreading of heat for top-of-range cooking, use stainless steel pans with aluminum or copper bottoms. Because of its thickness, cast iron heats up slowly; it is better for long cooking processes than for short jobs. Glass and ceramic glass are poor conductors of heat for top-of-range cooking but are good absorbers of radiant (oven) heat.

Use a minimum amount of water for cooking. (It takes energy to heat water.) Pans should be straight-sided and should be covered with tight lids whenever possible to retain heat. For better heat reflection from the unit to the pan, keep reflector pans or inserts shiny clean.

Always place a pan on a surface unit before turning on the source of heat. Turn off electric and smooth-surface units a few minutes before cooking is completed; use the residual heat to complete the cooking process.

OVEN COOKING

The efficiency of an oven depends on the amount of food cooked at one time. Baking one potato in a range oven would be poor use of energy, but using the oven to prepare a complete meal for a family would increase the efficiency of the oven considerably.

Shop and plan ahead for meals so you can use the oven to prepare double or triple batches of food; refrigerate or freeze the extras for future meals. Defrost foods before cooking. Preheating the oven is unnecessary unless you are preparing foods that contain leavening agents. Put leavened food in to bake as soon as the oven is preheated.

Don't be a "peeker" when baking or roasting. Every time the door is opened, the oven temperature drops 25 to 75 degrees. The oven must then turn on to replace the heat that was lost. Make sure your oven thermostat is accurate, and use a timer to tell when to check the food. Cure yourself of the "peeking" habit.

Glass and glass-ceramic cooking utensils absorb radiant heat well and allow cooking at temperatures 25 degrees lower than levels required by metal cookware. Bake and roast carefully; clean spills and spatters before they bake onto the oven surface. This reduces cleaning time later on and saves energy if you have a self-cleaning oven.

SPECIAL AND SMALL COOKING APPLIANCES

Because small cooking appliances have enclosed heating elements, they often require less energy for a cooking job than an oven or surface units of a range. Substitute small appliances, if you have them, for the range. An electric frypan can be used for frying, baking, stewing, and broiling; and it is energy efficient. For example, less energy is required to cook hamburgers on an electric skillet than on a surface unit of an electric range. Coffeemakers, toasters, toaster ovens, broilers, and egg cookers are similarly efficient.

Another versatile and energy-efficient kitchen utensil is the pressure cooker, which requires only one-third the time of conventional cooking methods. Oven cooking in plastic bags and in aluminum foil also reduces cooking time and thus saves energy.

FOOD PRESERVATION

Food preservation accounts for a sizable amount of all energy used in the home. To keep your refrigerator and freezer operating efficiently, clean the condenser coils to remove dust and defrost the evaporator. Allow for air circulation around the condenser. Place the refrigerator or freezer away from heat sources such as the range, a heat register, or a sunny window.

Buy food in quantity to decrease the number of shopping trips. Cook and freeze in quantity. Try to reduce the number of times you open a refrigerator or freezer, especially in hot, humid weather. Unused portions of refrigerated food such as milk should be returned to the refrigerator as soon as possible. If you think ahead during meal preparation, you can remove and return several items at the same time and thus reduce the cooling load on the unit. Because bacteria grow rapidly in food held at room temperature, cool hot items for only a short time before refrigerating them.

Freezing food requires more energy than refrigerating it; therefore, if food will be used within a few days, store it in the refrigerator, not the freezer. When defrosting foods, such as a roast, place them in the fresh food section of the refrigerator so they can help cool the refrigerator.

SOURCE: Cooperative Extension Service, Cornell University, Ithaca, New York.

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FACT SHEET

UNITED STATES
DEPARTMENT
OF AGRICULTURE

ENERGY
CONSERVATION
IN THE RURAL HOME

Keeping Home Heating and Cooling Equipment In Top Shape

Proper selection, installation, and maintenance of your heating and cooling system can save you money, improve comfort in your home, and improve reliability. When selecting a home heating and cooling system, explore all the available alternatives.

Don't Heat or Cool Space Not Being Used

Perhaps you can operate your home more efficiently by changing your current heating and cooling routine. If you can get along without heat in some areas of your house, turn it off. Some rooms or areas may need only a minimum amount of heat; others may need heating or cooling only occasionally. Regulating the heating in this way can reduce your energy costs significantly.

When practical, heat or cool the rooms in the center of the house and let the outside rooms serve as an insulating barrier.

You can adjust the heating and cooling in rooms by opening and closing registers. If your registers aren't adjustable, consider replacing them. If you have a water system or steam radiators that can't be turned off, install bypass lines or shutoff valves as needed to control the system and protect it against freezing. Thermostatically controlled valves in each room provide the most effective system.

In large homes single-room heating units can help to reduce demand on a central system. The central unit can be operated at a low temperature setting throughout the house while the small units can boost the temperatures in rooms being used the most.

Adjust Thermostat

In the Northeastern United States, 15- to 20-percent savings are possible with a reduction of 5° to 8° F in house temperature.

Setting your thermostat down at night to 55° F or below makes sleeping more comfortable. For the forgetful, clock-controlled thermostats can insure that temperature settings are adjusted on schedule.

Regulate Humidity

In the winter heat (or cold) spreads through your home fastest if the air is moist. However, you need humidity to protect your body from dry hot air in the winter. During the summer, you are more comfortable if you reduce the humidity in your home.

You may use humidifiers to add moisture removed by your hot air furnace system. Too much humidity, however, will cause mold-producing dampness and excessive condensation on windows. Dehumidifiers are good for controlling summer dampness, but are not especially good for comfort control.

The sun streaming through windows increases the load on an air conditioner. You can protect against this by blocking the entrance of the sun's rays. Keep drapes, blinds, and shutters closed when the sun is shining directly on them. Install awnings to shade windows. The overhang, or awnings, should extend far enough to provide full shade in summer but let in the sun in winter. Southern exposures need this protection the most.

Room Ventilation

Proper ventilation of your house can reduce or eliminate the need for summer air conditioning. You can use windows, doors (screened), and other natural ventilation or you can use electric fans. Natural ventilation may not be as cooling, but it may be sufficient and cost less than air conditioning. Ventilate your living space in the evening and or at night. Do not ventilate when your house is cooler inside than out. Keep the cool air trapped. Open vents or windows near the ceiling if you can to remove trapped hot air. Ventilation fans are particularly useful where evening breezes are not strong enough to move air through the house.

Your attic is a heat trap. While it serves as a buffer for the sun's heat, heat from the attic flows into the living area and increases the air conditioning load. Attics reach temperatures above the outside air early in the day. The attic should be ventilated by a fan as soon as its temperature rises above that of the outside to prevent a heat buildup.

Attics can be ventilated by either natural air currents or by fans. Either way, lots of air must pass through to be effective. Roof vents or louvres should provide a lot of open area for natural ventilation. Most homes have minimal louvre openings, only enough to avoid winter mositure problems.

Frequently a combination of soffit, gable, or ridge vents is used to ventilate attics without using a blower. Soffit and ridge vents are quite effective because the airflow is shorter. The ridge vent exhausts at a higher elevation than a gable opening. This creates a strong natural draft. Gable vent efficiency can be improved by locating a new house to permit prevailing winds to flow through the attic. For winter ventilation, the exhaust vent area (a similar area is needed for intake air) is 1 square foot for every 150 square feet of attic space. Effective summer ventilation requires much larger vent areas.

Ridge vents also increase natural ventilation by providing a short, direct airflow through the attic. The rotating cap of the cyclone acts as a low-capacity turbine. It can utilize wind power from any direction.

Powered fans operated from a thermostat reduce attic temperature levels automatically. The cost of operating the blower should be offset by savings in air conditioning loads. This, however, depends on the amount of insulation in the ceiling between attic and living space. The more the insulation, the less necessary a powered fan will be. When ceiling "R" values are high (above 30), it is still economical to install ventilation that operates on natural air currents.

Maintenance and Care of Equipment

The servicing and repair of furnaces usually require the attention of a serviceman. Homeowners can do some regular servicing and maintenance to keep the system operating efficiently. For safety, always keep the area around the furnace free of flammable material. Things the homeowner should check regularly are:

Air Filters Check the air filters of hot air heating systems every 6 weeks during the heating and cooling season. Clogged filters reduce airflow. This reduces effectiveness and increases energy bills. Some filters may be washed. Others must be replaced.

Electric Motors Follow the manufacturer's instructions for lubricating motor and blower bearings. Some bearings are permanently sealed and need no lubrication. Others need three to six drops of light motor oil every 6 months. Overoiling can damage a motor. Be sure oil holes are capped to keep dirt out. Wipe off excess oil or grease. Use clean rags to wipe dirt off the motor and clean ventilation openings. An accumulation of dust and dirt on the motor acts as insulation and may cause overheating.

Fan Belt A fan belt that's too tight causes excessive wear on the bearings. If it is too loose, it will slip, increasing belt wear and reducing blower efficiency. Allow a ¾-inch depression in the belt for each foot of distance between shaft pulleys when the belt is pressed with a finger midway between the pulleys. Check belt tension and alignment every 6 weeks when the air filters are inspected. If a new belt is needed, purchase the proper size and length. When installing a new belt, release the takeup adjustment on the motor and do not roll the belt onto the pulley. Check the vanes on the fan and remove accumulated dirt.

CAUTION: BE SURE THE POWER TO THE MOTOR IS SHUT OFF SO IT WILL NOT COME ON WHILE YOU ARE WORKING ON THE MOTOR, BELTS, OR FANS.

Humidifiers The major service problem with humidifiers results from mineral deposit buildup. This takes frequent servicing to avoid. As mineral deposits build up on the evaporator, efficiency decreases. Evaporator pads or plates should be cleaned or replaced when the buildup of salts interferes with evaporation.

Thermostat Thermostats may get out of adjustment and indicate the wrong temperature. Check the point at which they go on and off against the reading on a thermometer held near the thermostat. If the thermostat is not operating correctly, have a serviceman see if it needs adjustment, repair or replacement.

Registers and Radiators Dust on radiators, convectors, baseboard heating units, or in ducts acts as insulation and wastes heat. Vacuum them regularly.

If you have a hot water system, bleed air from radiators annually; open each radiator valve, hold a cup under it until water comes out. Don't drain the water. You only need to remove the air inhibiting water circulation.

Paint radiators with special radiator paint for best performance. Metallic paints and casings built around radiators reduce heat as much as 25 percent. If radiator covers are necessary, select ones that have grills over at least 75 percent of their surface. Place aluminum foil behind radiators to reflect heat into the room.

— Do not block air inlets and outlets, including radiators, with furniture, drapes, or clothing.

Heating Ducts Inspect heating ducts annually for leaks. Repair them with a quality duct tape.

Cover heating ducts and water for steam pipes that pass through unheated areas, attics, crawl-spaces and basements with duct insulation or unfaced R-11 insulating batts or blankets. If ducts are used for air conditioning as well as heat, use faced insulation and place the vapor barrier to the outside to prevent condensation on the duct.

Care of Fireplaces and Chimneys

Fireplaces are expensive to install and sometimes even cause substantial heat losses. Even the best fireplaces are inefficient as home heating systems. Fireplaces are effective in cool weather when needed to "take the chill" off a room. Air ducting systems that draw from the room into the fireplace and return heated air to the room improve the heating efficiency. Air for combustion should be ducted in from the outside rather than drawn from the room.

If you use a fireplace, arrange for a chimney checkup annually. Hot gases that escape through cracks in a fireplace can harm you and may even cause a fire.

Check the chimney for loose bricks and mortar and the flue lining (the passage through which the air and gases travel) for cracks. Make repairs before using your fireplace.

Be sure that the damper at the top of the fireplace closes tightly; otherwise, warm air will escape when the fireplace is idle.

In summer, keep the damper closed to prevent sooty backdrafts and birds from entering the house.

Soot and creosote accumulations should be cleaned from the flue each year. Do this by pulling a weighted sack of straw up and down the flue. Seal the front of the fireplace before you begin to keep the mess contained.

Selecting or Altering A Heating Or Cooling System

When you replace or alter a heating system you will decide whether to use: (1) Solid, liquid, gaseous, electric, or solar fuels; (2) room units or central systems; (3) separate or combined heating and cooling systems; (4) air or water distribution systems; (5) a gravity or forced air distribution system; and (6) a manual or automatic control system.

Fuels

Fuel availability, costs and delivery charges differ from location to location. To decide on the right fuel, first find its heating value in therms or other energy units. Then determine the efficiency with which a heater can convert fuel to usable heat. Solid and liquid fuels require onsite storage. Electric and natural gas do not. Coal and wood probably will be more economical where they are readily available. Electricity is the cleanest fuel, followed by gas, oil, and solid fuels.

Room Units

Window air conditioners, underwindow heating, cooling units, space heaters, electrical and resistance heating devices are reasonably effective for heating or cooling single rooms. Unless equipped with blowers, large temperature variations may occur between the floor and the ceiling. Distribution of heat or cooling to adjacent rooms is poor.

Central Systems

Central systems heat or cool a whole house or apartment. They provide a uniform temperature distribution but cost much more to buy and install than room units. They require more energy to operate.

Central systems may employ gravity or forced air to distribute hot air, cold air, water, or steam. Although gravity systems are effective, they are difficult to design and the ducts take up a lot of space. Forced air systems generally provide more uniform heat distribution than do gravity systems. Hot water or steam systems require the services of a plumber and usually need more maintenance than other systems.

Heat Pumps

Heat pumps come both as package units that fit into the wall and as connected split systems. Split units are more expensive but more versatile than the smaller units, since the inside unit can be located anywhere in the house. Heat pumps both heat and cool on demand. They are more expensive than other systems, but where the climate is not severe operating costs may be one-third to one-half that of conventional electric heating. However, heat pumps may still cost more to operate than most nonelectric systems.

Control Systems

Most heating units can be either automatically controlled or operated manually. Cost increases with the degree of automation. However, poor manual control can result in overheating.

Distribution of Heating or Cooling

Central heating and cooling systems usually depend on air distribution. Air responds rapidly to thermostatic demand. An air system frequently costs less and is easy to install. Water or steam heating systems are generally more effective in conveying heat from the furnace and control comfort of individual rooms more evenly. A liquid system requires less space than do air ducts but responds slowly to the thermostat. Water heat can add difficult plumbing problems. Liquid systems offer superior efficiency in large buildings.

Facts Sheets In The Home Weatherization Series

1. Why Weatherize Your Home?
2. How To Determine Your Insulation Needs
3. Saving Heating And Cooling Dollars With Weatherstripping And Caulking
4. How To Save Money With Storm Doors and Windows
5. What To Look For In Selecting Insulation
6. How To Install Insulation For Ceilings
7. How To Install Insulation For Walls
8. How To Install Insulation For The Floor And Basement
9. Solving Moisture Problems With Vapor Barriers And Ventilation
10. Weatherize Your Mobile Home To Keep Costs Down, Comfort Up
11. Tips On Financing Home Weatherization
12. Keeping Home Heating And Cooling Equipment In Top Shape
13. Landscaping To Cut Fuel Costs
14. Home Management Tips To Cut Heating Costs
15. Locating New Home Sites To Save Fuel

Single copies are available upon request to Special Reports Division, Office of Governmental and Public Affairs, U.S. Department of Agriculture, Washington, D.C. 20250.

This series of fact sheets was assembled from research, Extension and other sources by the USDA Task Force on Weatherization.

Agricultural Fact Sheet 2 - 3 - 7
United States Department of Agriculture
Office of Governmental and Public Affairs
Washington, D.C. 20250

August 1978

COOPERATIVE EXTENSION SERVICE

UNIVERSITY OF ARKANSAS Division of Agriculture, U. S. Department of Agriculture and County Governments Cooperating

ENGINEERING AND YOUR HOME

HEAT YOUR HOME WITH A MINIMUM OF ENERGY

Here is a list of steps that can be taken to reduce the fuel required to heat your existing home.

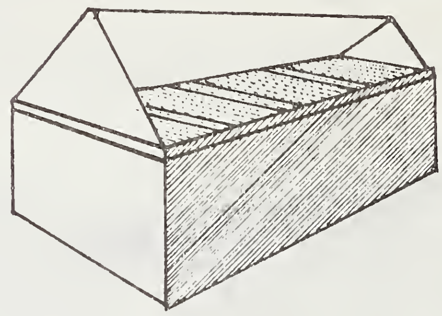
1. Stop air infiltration into the house from outdoors. Windows and doors should be weatherstripped and caulking should be applied around door and window frames as well as to any other cracks that may allow air to blow in from outdoors. All broken windows, including the cracked ones, should be replaced.

2. Stop air leakage from the heated area to the attic. Pull-down staircases and attic access openings should be weatherstripped. Ceiling ventilating fans, primarily used for summer cooling, should be covered and sealed. Any other penetrations into the ceiling such as light fixtures or heating ducts should be inspected to make certain that heated air cannot move around them into the attic. NOTE: Do not close attic ventilation to outside air. Attic ventilation is necessary to remove moisture that can cause condensation problems.

3. Prevent heated air from escaping to outdoors. Keep fireplace dampers tightly closed except when the fireplace is in use. The damper should be closed again immediately after the fire is dead. Use ventilating fans over cooktops or in bathrooms only when necessary and then for the minimum time to remove odors or excessive moisture. Discourage children or other family members from making unnecessary trips in and out of the house. Keep exterior doors closed as much as possible.

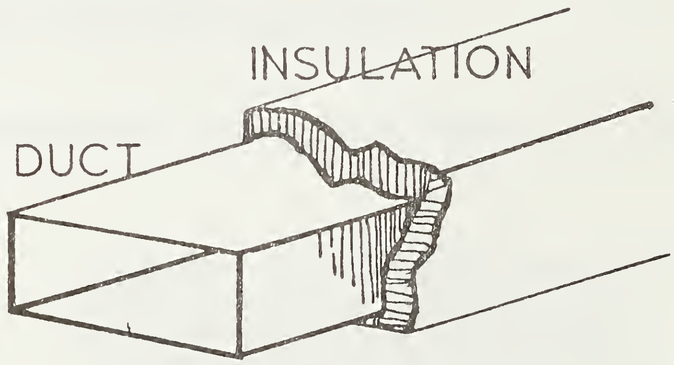
4. Adequately insulate your home — this means all areas that are heated. The greatest heat loss is in the ceiling, so insulate it first. Provide a MINIMUM resistance, or "R" factor, of 19. This requires about 6 inches of batt insulation of the glass fiber or mineral fiber insulators. It may

take as much as 8 or 9 inches of blown insulation to equal a 6-inch batt, depending on the type of material used and the way it is installed. Floors should be insulated with a MINIMUM of R-11 insulation, which means a 3½-inch batt of glass or mineral fiber insulation. The walls of older homes can be insulated, but it is generally expensive and complicated by the necessity of a vapor barrier being installed on the interior side of the wall to protect the insulation. Therefore, it may be advisable to make all other weatherization improvements first, unless a remodeling project is underway, and the exterior walls are easily accessible for insulation.



5. Reduce heat loss through windows and doors by installing double glass windows and storm doors. The storm door is simply a second door, generally glass, that provides an air space between two doors to give some insulating effect. Double glass windows may be insulating glass (two panes of glass fused together with an air space between) or storm windows (a second single pane sash applied over an existing window).

6. Have your furnace and duct system inspected to insure it is in good condition. Duct work should have no leakage and should be well insulated as well as wrapped in a vapor barrier. Furnace filters should be kept very clean. The furnace burners (if gas or oil) should be checked for proper burning. Gas burners should operate with a blue flame that shows little or no yellow tint. This can be adjusted.



7. Check the location of your thermostat. It should be on an interior wall four to five feet above the floor. Be careful not to locate it in direct sunlight or near air ducts or appliances. Hot spots or cold spots can "fool" the thermostat.

8. Maintain a relative humidity of at least 40% in the home. This can probably be accomplished by making the home "tighter" and cutting out excessive air infiltration. However, commercial humidifiers are available if needed.

9. Regulate draperies to take advantage of solar energy. Open draperies any time that sunlight can beam directly into a window. Close draperies at night, on overcast days, and on shaded windows. NOTE: Dark colored interior furnishings will absorb and re-emit more solar energy than light colored furnishings, so the results of this practice will vary from home to home.

10. Turn back the thermostat several degrees and wear more clothing at home.

John Langston

John Langston
Extension Agricultural Engineer

JL:pm

COOPERATIVE EXTENSION SERVICE

UNIVERSITY OF ARKANSAS Division of Agriculture, U. S. Department of Agriculture and County Governments Cooperating

ENGINEERING AND YOUR HOME

MAKING THE MOST OF SUMMER COOLING

Refer to newsletter "Heat Your Home With a Minimum of Energy." Those pointers along with these listed below generally apply to cooling.

1. The use of draperies or window shading over windows will significantly minimize the cooling load on your air conditioner. Heat gain through windows on the east and west side of the structure can be reduced by as much as 35% with the use of draperies and 20% with the use of roller shades.

2. Duct insulation for a central cooling system is critical. For duct systems located under the house in a crawl space, 1 inch is generally considered adequate, but duct systems located in attics should have no less than 2 inches because of the high attic temperatures. When you consider the year-round benefits of duct insulation for heating and cooling, I would recommend no less than 2 inches of duct insulation even if located in the crawl space. Duct insulation must be carefully wrapped with a vapor barrier if the system is used for cooling, or condensation will occur in the insulation. Pay particular attention to the insulation and vapor barrier wrapping on duct systems in attics at the point where they turn down into the ceiling. A poor wrapping job at this point can result in a water-stained ceiling because of condensation.

3. Inspect and change air conditioning filters at regular intervals. Every three months is about right for most areas in Arkansas. However, rural homes on dirt roads or in dusty areas may require more frequent changing. Once a month for inspection is not too often. A dirty filter restricts air flow through the system which has the initial effect of reducing the system's efficiency, but can result in a damaged condenser unit if allowed to go unattended. An air conditioner must have a specified volume of air moving through it or it will not operate properly!

4. The condensing coil should be cleaned out at least once per year. This is a part of the unit that sits in the yard. Grass clippings, spider webs, dirt, etc., will accumulate there. Always turn power off before cleaning! A water hose will do a good job, but allow the unit to dry thoroughly before turning the power back on. Keep bushes and shrubs cut back from the condensing unit at least 1 foot if possible. Air must circulate through the condensing coil for the system to operate properly.

5. Clean out condensate drain lines at least once per year. This is the line that drains the condensed water from the evaporator coil that is usually located inside the house. It can generally be cleaned by pushing water back through it with the garden hose. Use only a little water or you will have a flood in the house!

6. Have your system serviced once a year by a reputable serviceman. The compressor charge and the amperage draw to the compressor may need to be checked. Electric motors need a light oiling about once per year. There is a blower motor in the air handling unit (normally found inside the house) and a fan motor found in the condensing unit in the yard. Be sure that all power is turned off to both the compressor unit and the air handling unit before any cleaning, oiling, or servicing is attempted.

John Langston

John Langston
Extension Agricultural Engineer

JL:pd

CONSUMER INQUIRY

ACCOUNT NO. ______________________ I.D. ______________________ DATE ______________

NAME ______________________________ AMOUNT OF BILL ______________ BY ______________

LOCATION ______________________________________ HOME PHONE ______________

REPORTED BY ______________________________ VIA ______________

CUSTOMER COMMENTS ____

____

APPLIANCE	KWH	NO.
REFRIGERATOR	165	
FREEZER	125	
RANGE	129	
M/W OVEN	16	
WATER HEATER	375	
WASHER	8	
DRYER	108	
T.V. (B&W)	33	
T.V. (COLOR)	45	
DISHWASHER	30	
COFFEE MAKER	9	
FRY PAN	16	
ROASTER	17	
HAND IRON	12	
RADIO/STEREO	9	
ELECT. BLKT.	35	
TOASTER	3	
FAN	97	
PUMP	50	
LIGHTS	125	
HOT PLATE	8	
TOTAL		

TYPE OF DWELLING ______ CBS ______ FRAME ______ M/H ______

LENGTH OF TIME IN HOME ______________

ADULTS ______________ CHILDREN ______________

KWHS, CURRENT ______________

KWHS, BASE ______________

KWHS, INCREASE ______________

COMFORT KW ______________ HRS. ______

HRS. ______ DAYS ______ HRS./DAY ______

AIR COND. ______________ TEMP. ______

HEAT ______________ TEMP. ______

POOL ______________

NOTES:

SUMMARY

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E&E 1-1

Cooperative Extension Service

UNIVERSITY OF ARKANSAS Division of Agriculture, U. S. Department of Agriculture and County Governments Cooperating

ENERGY $

LIGHTING TIPS FOR ENERGY CONSERVATION

Elizabeth Ellis
Extension Specialist - Household Equipment

About 20 percent of the total energy used in the U.S. is consumed in and around the home with about 5 percent of this energy used in lighting. It is so easy to use more lighting than you need, but careless use contributes to higher electric bills and wastes energy.

The following information on lighting for energy conservation can help reduce the cost of electricity in your home while assisting in nationwide efforts to conserve energy.

FLUORESCENT LIGHTING

The use of fluorescent lighting is one of the easiest ways to save both money and energy. It has been the standard light source for years in commerce and industry. Where fluorescent rather than incandescent lighting is used in the home, savings can range from 29 to 66 percent, an average savings of 45 percent. Fluorescent tubes produce three or four times as much light as an incandescent bulb of the same wattage, and they also last seven to ten times longer. For example, one 40-watt fluorescent tube provides more light than three 60-watt incandescent bulbs.

The main objections to the use of fluorescent lighting in the home are (1) the limited selection of attractive fixtures, and (2) the harsh effects of the cool light from some fluorescent tubes. However, a warm, homey environment can be created with well-designed fluorescent tubes in rooms such as the kitchen, utility room, and bathroom, or by using indirect deluxe warm white fluorescent lighting in the bedrooms in the form of a lighted cove. Incandescent bulbs can be used for "fill" or accent lighting.

In planning new homes and remodeling present ones, consumers and builders should consider the advantages of fluorescent lighting, as well as the significant savings in electricity costs and energy.

INCANDESCENT LIGHTING

Incandescent bulbs are packaged in wrappers that give the average life and initial light output for the bulbs. The average life of a bulb designed for household use may range from 750 to 3,500 hours, depending on the bulb type and the way it is used. The four most common light bulbs are standard inside-frosted, soft white, three-way, and long-life.

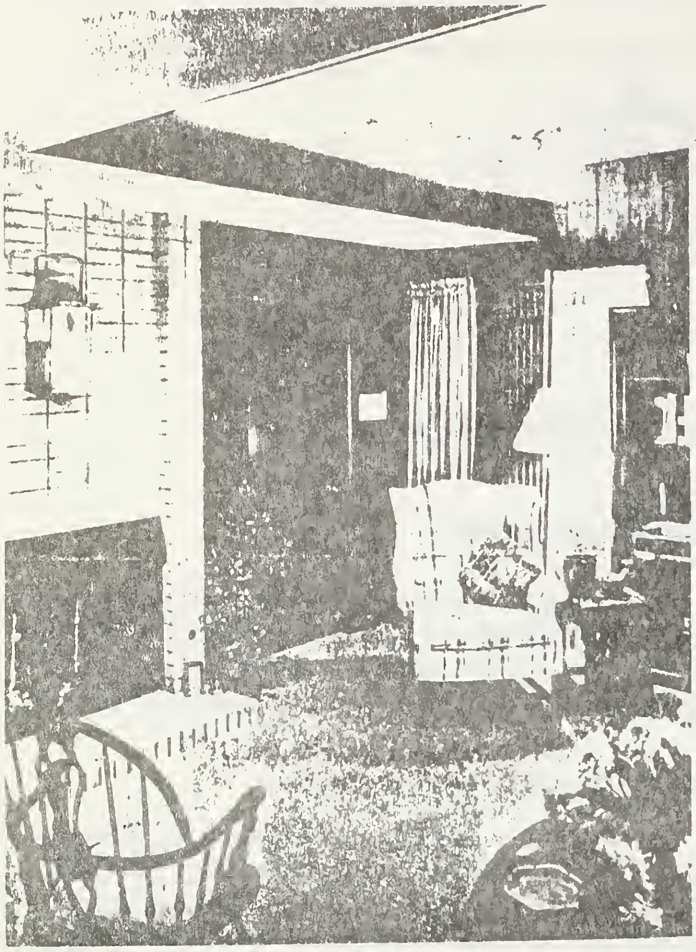
COMPARISON OF LAMPS

Type of lamp	Size by watts	Average output in lumens	Average hours of life	Average lumens per watt
Incandescent (standard)	25	225		9
	40	430		11
	50	630		13
	60	810	750	14
	100	1,600	to	16
	150	2,500	1,000*	17
	200	3,500		18
	300	5,490		18
Fluorescent (standard)	15	660		34
	20	1,000	18,000	40
	40	3,200		60

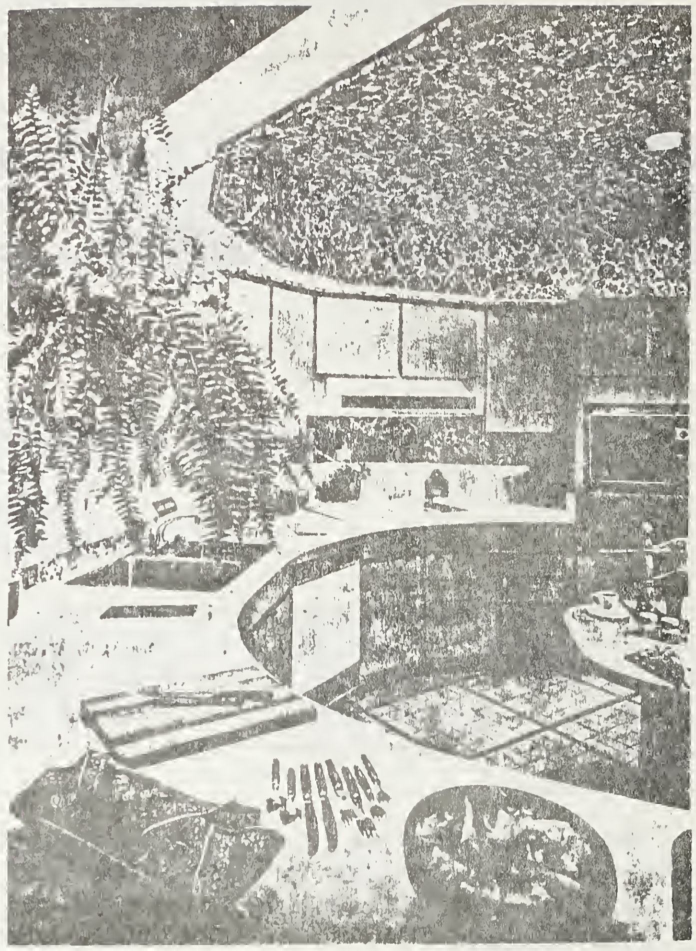
*Longer life lamps (up to 3,500 hours) are available at a higher initial cost. They produce 10-15 percent fewer lumens per watt.

ENERGY-SAVING TIPS

Whatever type of lighting you choose for your home, be sure to keep lamps and lighting fixtures clean and free of dust. Dirt absorbs light and cuts down on lamp efficiency. Darkened bulbs also give



Incandescent fixtures can be used for "fill" or accent lighting in combination with fluorescent architectural lighting.



A warm, homey atmosphere can be created by using a lighted soffit.

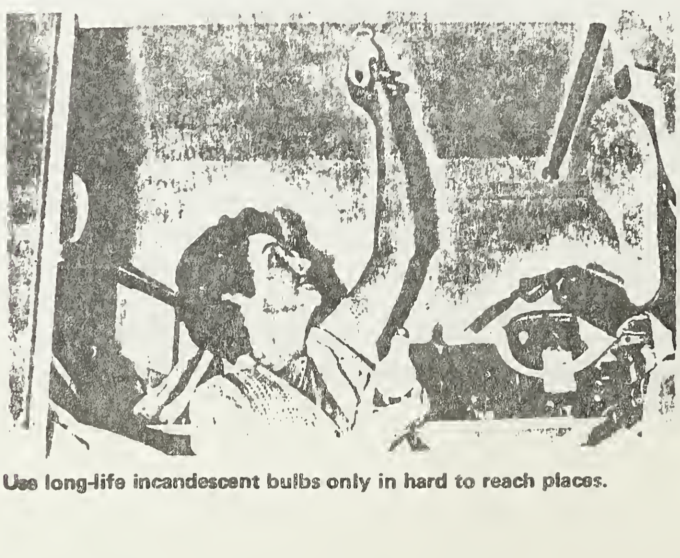
less light than their rated output while using the same amount of power. For the most efficient use of energy, darkened bulbs should be replaced before they burn out.

Long-life bulbs are not a good investment when considering energy conservation. They do last longer, but with lowered efficiency and wasted energy. Theoretically, to produce the same amount of light as a regular 100-watt, 750-hour light bulb, a 5000-hour, long-life bulb would have to be 130-watts. During this imaginary bulb's life, it would consume an extra 150 kilowatt hours. Therefore, these long-life bulbs should be used only in hard-to-reach places.

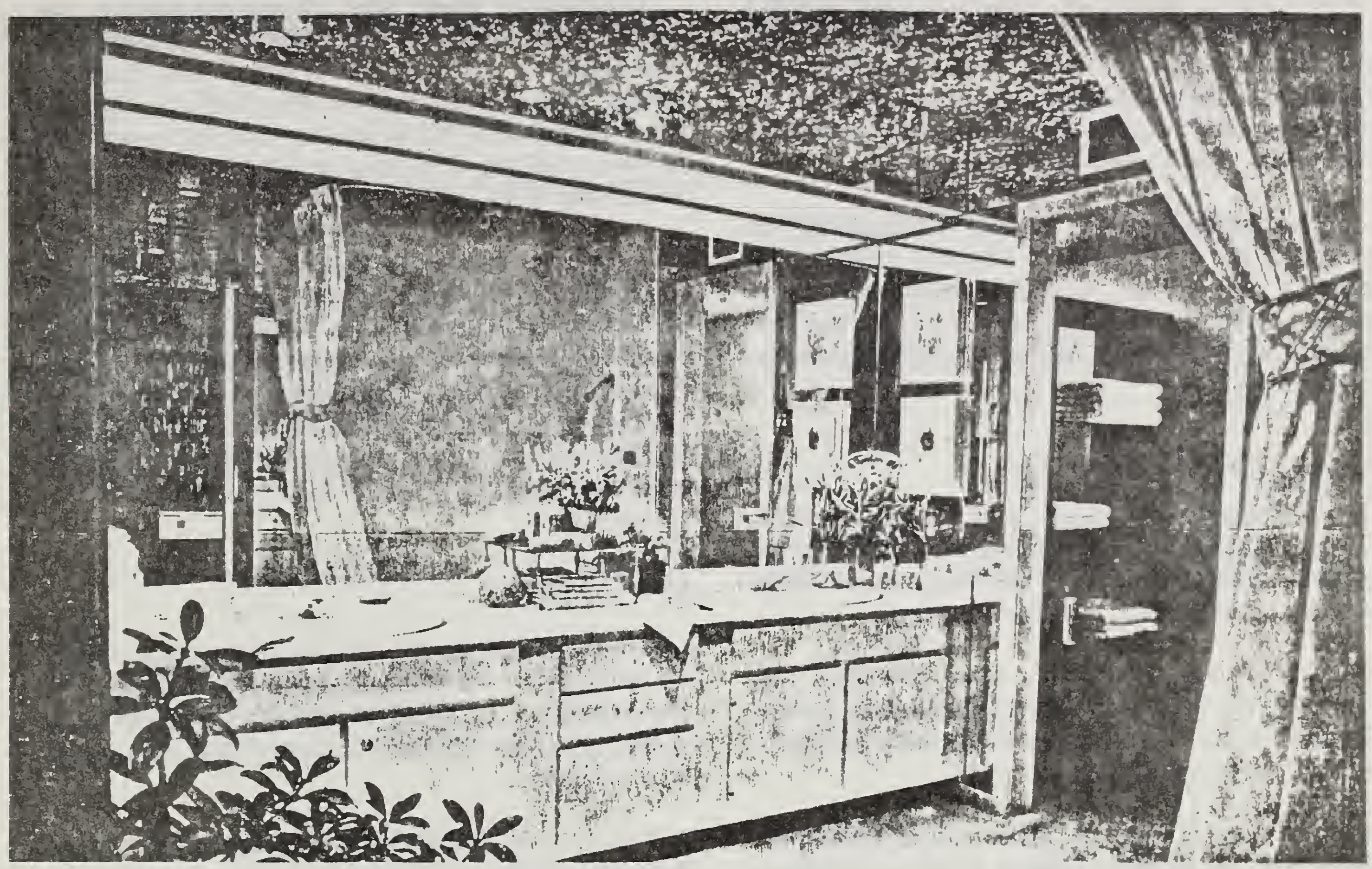
Dimmer switches are helpful in conserving electrical energy. Inexpensive and easily installed, a dimmer gives lighting flexibility as well as more efficient use of light. In addition, a dimmer switch can create interesting atmospheres with various levels of light, adding a decorative touch to areas such as the dining room. A dimmer on fluorescent and incandescent bulbs allows you to provide light from zero to full brightness.

If you want fluorescent lighting with dimming features, you will have to install a fixture complete with a special rapid-start dimming ballast. This is best done when the system is first installed. It should be noted that fluorescent tubes do not change color as much as incandescent bulbs when they are dimmed.

Three-way bulbs are energy-savers for the same reasons as dimmer switches. Three-way bulbs can



Use long-life incandescent bulbs only in hard to reach places.



Fluorescent tubes provide efficient lighting for make-up and grooming.

be turned on "high" for reading or working and on "low" for energy conservation.

Another type of control that can add flexibility to your lighting system is the use of timers which turn lights on and off when you are away. They may also be used to turn the coffeepot on at a set time each morning. And, you can save energy by plugging your "instant-on" television set into an outlet controlled by a timer or by a wall switch. Without these devices, "instant-on" television sets use electricity even when the screen is dark.

Turn lights off when not in use.

Since light bulbs in 40-watt sizes and above are subject to breakage if spattered with water or other liquids, they should be protected or shielded if used where spattering is likely to occur. Also, the maximum recommended wattage for a fixture should not be exceeded. Even though a higher wattage bulb may fit a fixture, it can cause the wiring to overheat.

Of course, turn lights off when not in use. This is especially important in summer since about 95 percent of the energy used by an incandescent lamp is released as heat. Sometimes it is helpful to place signs above light switches, reminding family members to turn lights off when they leave a room. However, use common sense when moving from room to room. The life of a fluorescent tube may be shortened by constantly turning off and on. Proper placement of light switches will help reduce energy consumption. Rooms having more than one doorway, such as kitchens, dining rooms, and living rooms, should have switches at each doorway so that lights can be easily turned off. This reduces the likelihood that lights will be left on when the rooms are unoccupied.

When trying to get the most for your lighting dollar, one important point to consider is room color. Light colors for walls, rugs, draperies, and upholstery reflect light and reduce the amount of lighting required. Clean dirty or dingy walls and choose light colors when painting rooms.

During daylight hours, open your draperies or blinds and let in sunlight to brighten your rooms naturally. In winter, sunlight helps cut down heating costs. In summer, let in only indirect sunlight as heat from direct sunlight increases cooling costs.

MORE EFFICIENT LIGHTING

For efficient use of energy, give special attention to ways that lights can be used to fulfill their purpose, whether for general lighting, special visual tasks, safety or security, or grooming.

If a table lamp is the main source of light, the lower edge of the shade should be slightly below eye level when you're seated so that the light doesn't shine in your eyes.

For best use of light for make-up and grooming, replace the incandescent fixture in your bathroom with two 20-watt deluxe warm white fluorescent lamps.

Lower wattage bulbs can be used in halls, closets, bedrooms, dining rooms and general living areas since bright lighting usually is not needed in these places. Three-way lamps are useful in bedrooms and living rooms where a higher beam is needed for reading.

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In order to assure safe movement through the house when eyes are dark-adapted, a four-watt night-light is now available that uses half the energy of the standard seven-watt bulb, but has the same average life (3,000 hours). The four-watt bulb is clear, making it appear as bright as the coated seven-watt bulb.

Many people like to have outdoor lighting for convenience, personal safety, and to discourage vandalism. Light bulbs made especially for outdoor use are projector or PAR bulbs. Made of heat- and cold-resistant glass, they come in a variety of wattages and colors. For most efficient use, outside lighting can be put on a photocell unit or timer for automatic turnoff.

CONCLUSION

Although lighting is not one of the biggest users of energy in the home, lights do use energy. Consequently, by using these lighting tips in your home, you can conserve energy and live more economically.

For further information contact your county Extension office.

SOURCE: Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Florida 32611.

Extension Home Economics

CHANGE OFFICE LAMPS (2700 hours per year)		ENERGY SAVINGS/COST SAVINGS kWh	GJ	3¢/kWh	5¢/kWh
from	*to*		*to save annually*		
1 300-watt incandescent	1 100-watt mercury vapor	486	5.25	$14.58	$24.30
2 100-watt incandescent	1 40-watt fluorescent	400	4.32	12.00	20.00
7 150-watt incandescent	1 150-watt sodium vapor	2360	25.5	70.80	118.00
CHANGE INDUSTRIAL LAMPS (3000 hours per year)					
from	*to*		*to save annually*		
1 300-watt incandescent	2 40-watt fluorescent	623	6.73	18.69	31.15
1 1000-watt incandescent	2 215-watt fluorescent	1617	17.5	48.51	80.85
3 300-watt incandescent	1 250-watt sodium vapor	1806	19.5	54.18	90.30
CHANGE STORE LAMPS (3300 hours per year)					
from	*to*		*to save annually*		
1 300-watt incandescent	2 40-watt fluorescent	685	7.40	20.55	34.25
1 200-watt incandescent	1 100-watt mercury vapor	264	2.85	7.92	13.20
2 200-watt incandescent	1 175-watt mercury vapor	670	7.24	20.10	33.50

RELAMPING OPPORTUNITIES

TABLE 9.6

1. The full potential for energy savings which may be achieved from reduced levels of illumination in office areas has not yet been achieved. Under the nonuniform concept, where lighting is concentrated at the work stations (desk tops), care must be exercised in selecting the fixtures which should have their lamps removed. Lighting levels at work stations for general office work under the nonuniform lighting concept should be reduced to approximately 50 ft-candles. As a general guide, one watt per square foot for lighting should be the maximum allowed. Lighting levels in warehouse and records space should be reduced to the maximum extent and utilized only in those areas in which people are working and while they are working.

2. Fixture location in relation to the fixed desk location is the major consideration. Therefore, the most desirable location for fixtures or lamps remaining energized should be directly over the desk or the sides of the desk where they will not create reflections. Care should be taken to ensure that surroundings seen by the worker do not become dark, producing visual discomfort.

3. In removing lamps from existing fixtures, always remove all lamps that are operated by the same ballast. When these tubes are removed from fixtures without disconnecting the ballast, the ballast energizing current is very small, particularly in the case of the rapid start series-lead type that have been specified for the past 10 to 12 years. During normal operation of a fixture with four 40 watt lamps, the two ballasts and four lamps will use a total of about 185 watts. With the removal of two tubes leaving both ballasts in place, the wattage is reduced to about 100 watts per fixture. There are, however, some older type fixtures in our buildings such as lead-lag, preheat, and instant start that may not have a similar wattage reduction with the tubes removed. Consequently, it is necessary that a check be made of the type of fixtures used in our buildings and where the use of a single phase wattmeter indicates the ballast consumes 15 watts or more, the ballast should be disconnected and the tubes removed. Do not use a ammeter and voltmeter to obtain wattage readings because the results will be incorrect.

NONUNIFORM LIGHTING LEVELS TABLE 9.7

4. Certain building areas should not receive the nonuniform treatment. Where more difficult seeing tasks require a higher level of illumination, reductions should be made only to the level appropriate for the task being accomplished. These areas include drafting rooms, computer rooms, and areas containing printing presses or rotating machinery where lower illumination might result in a hazardous condition.

5. Lamps in the corridors, lobbies, toilet rooms, and other public spaces should be removed to the maximum extent possible without creating a hazardous condition. In these nonwork areas and other similar space, lighting levels of between 25 to 30 ft-candles are specified. All outside architectural lighting (except security lighting) should be extinguished.

6. To the extent possible, at the time that this nonuniform conversion is made, all fixtures should be cleaned and those to remain in operation provided with new lamps. This will increase the light output of the fixtures remaining approximately 15% or 20% initially, and provide a psychological boost toward the acceptance of this new concept by the employees occupying the space. The fixtures to be left without lamps should be marked to prevent inadvertent relamping.

7. Occupants of the space affected should be made aware of the purpose and intent of the lowering of lighting levels well in advance of implementation to gain their acceptance of the plan.

8. Special consideration should be given to those employees who have particular problems relating to vision or unusually ardous visual tasks.

Reference 12

Note: Certain items (e.g., 1, 5) in this table are controversial. It should be noted that the table reflects what the government did to public buildings during an emergency, and these measures are not necessarily recommendations for other buildings during normal times.

TABLE 9.7 CONT'D

EXTENSION ENERGY CONSERVATION

COOPERATIVE EXTENSION SERVICE/UNIVERSITY OF GEORGIA COLLEGE OF AGRICULTURE/ATHENS

Lighting

Lighting plays a very important part in your life. Work, study, recreation, decorating, safety, and security depend on it. Although lighting does not account for a large part of the energy picture, by using it wisely, you can save light without losing its benefits.

Energy-Saving Tips

There are a number of obvious ways to curtail extravagant use of energy for lighting. Turn lights off when you leave a room for more than 15 minutes. Remember, though, that frequent on-off switching shortens fluorescent bulb life. Invest in night lights if you need light in bathrooms, halls, and bedrooms after bedtime.

Keep lamp bulbs, lamp and fixture diffusers, and shades clean. Dirt and dust sometimes absorb light by as much as 50 percent. Replace darkened bulbs with new ones, saving the old ones as spares or for use in places where quantity of light is not too important.

Utilize all the light in a room to the fullest. Place lamps where they will do the most good. Whenever possible, use light-colored reflecting surfaces. For example, make a dark desktop a better study place by covering it with a light-colored blotter. When you paint walls, remember that dark colors absorb light.

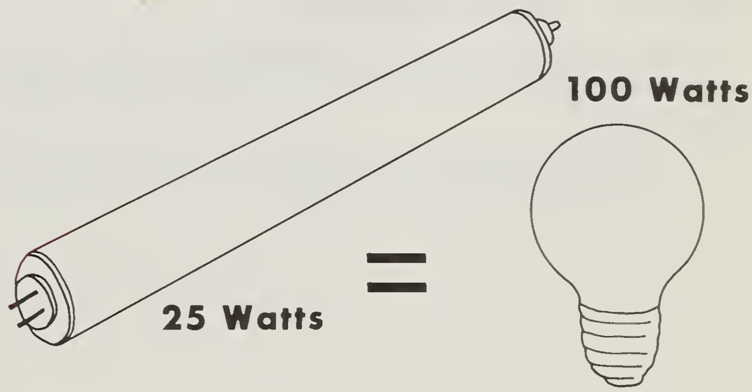
Three-way lamp switches are easy to install. By converting lamps from one-way to three-way use, you can choose the best level of light for the occasion and use the highest level only when necessary.

Dimmers are also easy to install in lamps or as wall controls for fixtures. They help to adjust the level of light and also add "atmosphere" to your home.

Buying Lamp Bulbs

There is a lot of information on the cardboard jacket of a lamp bulb. In addition to the wattage, you will find the average life, expressed in hours, and the initial amount of light the bulb puts out, expressed in lumens.

Incandescent lamp bulbs used in residences have an average life of 750 to 1000 hours. Fluorescent bulbs last an average of 15,000 to 20,000 hours. Incandescent bulbs labeled "long life" last up to 2,500 hours. They are not a good energy buy, however; they cost more and give 10 to 15 percent less light than regular bulbs of the same wattage.



In addition to lasting longer, fluorescent lamps produce three to four times as much light as the same wattages of incandescent. For example, compare the following incandescent and fluorescent lamps:

Type of Lamp	Size in Watts	Average Lumen Output
Incandescent (standard)	25	250
	40	450
	60	840
	75	1150
	100	1700
	150	2700
Incandescent Three-Way (highest setting)	30-70-100	1250
	50-100-150	2150
	50-200-250	3850
	100-200-300	4600
Fluorescent (standard)	15	660
	20	1000
	40	3200
Fluorescent (deluxe warm white)	15	550
	20	800
	30	1500
	40	2100

Planning New Lighting

When you plan new lighting or replace existing fixtures, consider fluorescent. Fixtures holding two or four lamp bulbs are very satisfactory in kitchen, utility room, playroom, or family room. Wall lighting, using fluorescent strips shielded by a faceboard that matches or contrasts with the wall or draperies, makes fine light sources for any room. Lighted ceiling panels or soffits give excellent light for kitchens and bathrooms.

Some people think that fluorescent light distorts colors and is unattractive. Fluorescent lamps are made in a number of colors, some being better for residential use than others. Warm white is most flattering to skin tones, food, and furnishings. It combines well with incandescent because of the yellow in its composition. Cool white, on the other hand, produces a "cooler" light, because it emphasizes the blues and greens in the room.

Deluxe warm and cool lamps have red added to the spectrum to bring out the full range of color in the room. The light output of deluxe lamps is less than that of standard lamps, but life expectancy is the same.

Check Your Lighting

There is a simple way to determine how much light you need and how much you have in any room. Follow these steps:

1. Find the number of square feet in the room by multiplying length by width.
2. Multiply square feet by the appropriate figure below to get total lumens needed:

Living room	-	80 lumens per square foot
Dining room	-	40 lumens per square foot
Kitchen	-	80 lumens per square foot
Bedroom	-	70 lumens per square foot

3. Count the lumens of light in the room by referring to the chart in the section, "Buying Lamp Bulbs," or check the jacket of a new lamp bulb. Remember that the amount declines as the bulb ages.
4. If your lighting falls short of the desired amount, figure the best energy-saving way to add light.

Remember!

* Keep lamp bulbs, shades and diffusers clean.
* Replace dark bulbs which decrease in efficiency as they darken.
* Light colors reflect light, dark colors absorb.
* Place lamps where they will do the most good.
* One large bulb gives more light than several smaller ones, even though wattage is the same.
* Three-way switches and bulbs, as well as dimmers, add flexibility to lighting.
* Fluorescent lamp bulbs give three to four times as much light as incandescent bulbs of the same wattage, and last about 25 times as long.

Prepared by Doris Oglesby, Extension Home Economist

Grateful appreciation is expressed to the Georgia Department of Energy Resources for contributions made toward the printing of this material.

H & E 4

Miscellaneous Publication 62 April, 1978

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, the University of Georgia College of Agriculture and the U.S. Department of Agriculture cooperating.

Tal C. DuVall, Director

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CASE STUDY 4-3: ENERGY MANAGEMENT APPLIED TO RESIDENCES

THE CONCEPT

This case study shows how to save energy and money by the use of energy management practices in eight residential energy using areas. Measurements were conducted in a residence under typical operating conditions. Energy management options and efficient operational strategies are described and energy and dollar savings reported.

BACKGROUND

The study was conducted in a residence located in Southern California. The family (four persons) lives in a single story, wood frame house. The major electric appliances include lighting, a range with a microwave oven, dishwasher, refrigerator, clothes washer and dryer, and miscellaneous appliances. Space and water heating are natural gas. Calculations of savings and payback on investment are based on 1976 energy prices (5 ¢/kWh and 21 ¢/therm).

An energy audit was made on all energy using appliances and systems. Complete utility records were examined and meter readings were taken using the household gas meter, watt-hour meter and a portable appliance watt-hour meter. A temperature recorder was used to sense refrigerator and water heater operations. Light meter readings were taken to determine lighting levels.

FINDINGS

Energy Savings From Home Insulation

The residence is 150 m^2 (1600 ft^2) and has two gas-fired wall furnaces. One is rated at 13.2 kW (45 kBtu/hr) and the other at 10.3 kW (35 kBtu/hr). In 1973, 8.9 cm (3.5 in.) (R-11) of foil-backed fiberglas batting was added to the attic of the original house and to the dining room walls which were ripped apart during remodeling. (Two bedrooms which had been added to the original house already were insulated.) The family installed the insulation themselves, and the total cost was $150.

The added insulation saved 18 GJ (17 MBtu) in 1974, which amounted to $35 per year at 2.10 $/MBtu. This resulted in a four year payback. The following year the family turned off the gas pilot lights from June to October, recalibrated the thermostat and set it at 20°C (68°F) during the day and 15.6°C (60°F) at night. The wall furnace in the rear of the house was turned on only when someone was using that area. That year 23 GJ (22 MBtu) were saved which amounted to $46 per year. If these additional energy management strategies are taken into account, then the payback is reduced to 3.2 years at present prices.

It may be concluded that the savings due to insulation are significant even in a mild climate. The payback in several California homes which were studied ranged from three to six years. If the heating were electric, the weather more extreme, or air conditioning were used, the payback period would be greatly reduced.

The price of natural gas is expected to rise due to shortages and price deregulation. Escalation of natural gas prices can probably be expected to double fuel prices, cutting the payback in half. When this occurs, there will be a greater incentive to reduce thermal losses in the home.

The Efficiency of Water Heater Insulation

This section reports on the actual energy and dollar savings resulting from water heater insulation. The gas water heater holds 0.114 m^3 (30 gal) and is rated at 13.2 kW (45,000 Btu/hr). It is located outside the house (west side) in a galvanized steel enclosure. The measurements were made in May, in generally mild (typically 15-21°C;

60-70°F) weather. A seven day temperature recorder was placed on top of the water heater. Following the measurements the heater was insulated with 8.9 cm (3-1/3 in.) of R-11 foil backed, fiberglas insulation, held in place with duct tape.

The week before adding insulation, gas usage for water heating was measured at 0.95 GJ (0.9 MBtu). The week after insulating the tank, usage was down to 0.74 GJ (0.7 MBtu) --a saving of 0.21 GJ per week. The number of "turn-ons" (as evidenced by spikes in temperature records) went from 50 down to 37 after insulating. This is a 26 percent reduction.

The savings from insulation are estimated to be about 22 percent averaged over the year--about 11 GJ/yr. The cost impact of this would be to save approximately $21 per year. The cost of the insulation and tape was $10. Thus the payout period is 10 ÷ 21 $/yr = 0.48 years, or about six months.

Relamping With Fluorescent Lights

The most frequently used lights were replaced by fluorescent lamps over a two year period (1973-1975). To summarize, 1.11 kW of incandescent lighting was replaced by 0.515 kW of fluorescent lighting--a difference of 0.595 kW. In rooms with two or more fixtures, separate switches were installed.

The energy audit method was used to determine lighting use before and after adding fluorescent lamps. This was compared with historical records for additional verification.

Lighting levels for both fluorescent and incandescent lamps were measured. In most cases the fluorescent fixtures had a diffuser covering the tubes. The incandescent light was measured using a bare bulb.

The light meter measurements indicated substantially equivalent light levels in most rooms. In some areas illumination levels were reduced intentionally. In others, lower wattage (compared to incandescent) fluorescent lamps provided more illumination. Lighting levels (measured 75 cm [30 in.] above the floor) ranged from 110 lux (10 fc) in the halls to 320 lux (30 fc) in the study.

Light meter tests showed the greater efficiency of fluorescent lamps as compared with incandescent lamps. In some cases fluorescent fixtures gave off twice the amount of light for the equivalent wattage or gave the same amount of light as an incandescent bulb with twice the wattage.

Relamping with fluorescent lamps saved about 60 kWh per month. An additional 60 kWh was saved by the use of separate switches, delamping, turning off lights in unoccupied rooms, and reducing use of outdoor lights.

Savings of 120 kWh per month or 1,440 kWh per year translates into a saving of $72 a year. The cost was $220 for the fluorescent lamps, new switches, miscellaneous hardware and labor. The payback on this investment was roughly three years.

Energy Use in a "Frost Free" Refrigerator

Electricity use was measured and energy management opportunities in a refrigerator under actual operating conditions were investigated.

The 0.4 m^3 (19 ft^3) refrigerator is located on the west side of the residence. It is near a window and, therefore, receives some direct sunlight in the late afternoon. The measurement was made in May in generally mild (15.6-23.9°C [60-75°F]) weather. The ambient temperature in the kitchen varied from 19°C (66°F) to 22°C (72°F). The temperature inside the refrigerator averaged 4.4°C (40°F) and the freezer temperature averaged -13.9°C (7°F) when the compressor was off.

From 7:30 p.m. Sunday, May 2, to 7:30 p.m., Sunday, May 9, the refrigerator used 28.2 kWh or 4 kWh per day. This agreed with the data published in Reference 1. The total household electricity use averages 321 kWh per month, or approximately 10 kWh daily. The refrigerator accounts for 37 percent of the electricity used.

In the household where the experiments were made, this appliance used more electrical energy than any other appliance or system. At 120 kWh per month with a charge of 5¢/kWh, it costs $72 per year to operate.

Experiments show that opening the door has a moderate effect and should be minimized. The addition of warm or hot food should be avoided. However, even though the data show increased energy use from adding food and opening the door, the total daily energy use is little affected by these actions.

The most efficient strategy for saving energy with the refrigerator comes not so much from efficient operation but from making a wise purchase. The refrigerator should suit the family's needs but should not be larger than necessary. The larger the refrigerator and the more work-saving features it has, the more electricity it needs to operate.

In California, new efficiency standards have been proposed for refrigerators. Appliance manufacturers are developing more efficient, better insulated refrigerators that may save half the energy. These refrigerators may cost from 75 to 100 dollars more but the difference will be paid back in two to three years in reduced energy bills.

Energy Efficient Cooking

The energy use of typical cooking appliances was measured in order to determine more energy efficient cooking practices.

Measurements were obtained in a home during the process of preparing foods for a family of four. The appliances used in the study were: an electric range consisting of a smooth "Corning" cooktop (1.50 kW/burner), a large continuous cleaning lower oven (5.2 kW), and an eye-level microwave oven (1.3 kW); a toaster oven (1.0 kW); an electric fry pan (1.15 kW); a 5 liter crock pot (0.15 kW); and a 2 slice, pop-up toaster (1.0 kW).

The results of this study have been tabulated in Table 1. The microwave oven was found to be the most energy efficient and, as an extra bonus, cooked food more quickly. The toaster oven was efficient for some uses. Using the crock pot was another energy saving way to cook. It took longer but used much less energy than a conventional oven. The electric fry pan was another excellent energy saver. It used less energy than all other appliances tested for cooking chicken and stew.

The large conventional oven proved to use the most electricity. It took 0.5-0.7 kWh to heat the cavity to the desired temperature and then it cycled on and off every one to three minutes. In order to make proper use of a big oven, large amounts can be cooked and then saved for another day's meal. Or, a complete oven meal can be planned where the main dish, vegetable, potatoes and dessert are all cooked at the same time. Tabulated results show that the microwave oven used less (1.2 kWh) even though the items have to be cooked one at a time. For most families who do not have this option the complete oven meal is the best method (2.5 kWh). The worst case would be to bake the dessert earlier in the day and then use one oven for the main dish, one for the potatoes and the stove top for the vegetable (5.2 kWh)(see Table 2).

Better energy management in cooking can save money. For this family, estimated savings were about 50 kWh per month which translates into $30 per year. This was accomplished by purchasing a range with an eye-level microwave oven in place of an eye-level conventional oven. This range cost $150 more but saves about $30 per year and will be paid back in five years. A typical cost for a portable microwave oven is $300. This ten year payback is long but with energy prices continuing to grow it will be reduced. Considering the savings of time and human energy, this longer payback period can be justified.

Additional savings come from using the large oven only when cooking several dishes, keeping pots covered and using small portable appliances where appropriate.

Food item	Appliance	kWh	Min	Temp°F	Comments
4 baked potatoes	Large oven	2.3	60	400	No preheat
	Microwave	0.3	16		
	Toaster oven	0.5	75	425	
Chicken (cut up)	Large oven	2.0	65	350	
	Microwave oven	0.55	25		
	Fry pan	0.5	60	300-350	Two chickens were used
	Crock pot	0.7	6.5 hr.	lo & hi	in crockpot experiment
Meat loaf	Large oven	2.0	60	350	
	Microwave oven	0.22	10		
	Toaster oven	0.35	60	350	
Brownies(9 X 13"pan) 23 X 33cm	Large oven	1.6	30	350	Microwave quality not
	Microwave oven	0.22	10		as good as conv. oven
Corn bread	Large oven	1.5	20	350	
	Microwave oven	0.15	7		Not browned well in MW
Frozen peas(petite)	Stove top	0.16	6	hi	Brought water to boil & turned off burner. Peas continued to cook.
	Microwave oven	0.11	5		
Beef stew	Large oven	2.7	5 hrs.	275	
	Crock pot	1.15	12 hrs.	10	Beef is browned first
	Electric fry pan	0.7	4 hrs.	300	in fry pan method.
Toast (2 slices French bread)	Pop up toaster	0.035			
	Toaster oven	0.060			
Toast (2 slices regular bread)	Pop up toaster	0.025			It takes over 17 pieces of toast in broiler to toast more efficiently than 2 slice toaster.
	Large oven broiler	0.2			
Water (2 cups cold start)	Stove (lid off)	0.176	7	hi	
	Stove (lid on)	0.151	6	hi	
	Microwave	0.121	5.5		

COMPARISON OF ENERGY USE IN COOKING APPLIANCES **TABLE 1**

Meal	Cooked together in a large oven	Cooked separately in microwave oven	Cooked in separate oven, stove top & toaster oven
2.3 kg (5 lb) ham (canned)	2.5 kWh	0.55 kWh	2.5 kWh (large oven)
0.23 kg (0.5 lb) frozen petite peas		0.11 kWh	0.16 kWh (stove top)
4 medium yams		0.35 kWh	0.5 kWh (toaster oven)
23 X 23 cm (9 X 9") pineapple upside down cake		0.22 kWh	2.0 kWh (large oven)
	2.5 kWh	1.23 kWh	5.16 kWh

ENERGY USED IN COOKING A COMPLETE MEAL THREE DIFFERENT WAYS

TABLE 2

Energy Management Strategies in Clothes Drying

Clothes drying represents 20 percent of the electrical energy used in the residence.

The dryer power was 6.0 kW. It used approximately 0.3 kWh to heat up before cycling off for the first time. Typical performance was as follows:

- 5.75 pounds of "permanent press" fabric (sheets, pajamas, pillow cases, blouses) took 25 minutes to dry at the "wash and wear" setting and used 1.7 kWh. (Wet weight 8.5 lbs - dry weight 5.75 lbs = 2.5 lbs water removed.)
- A 6.75 pound mixed load (T-shirts, blouses, socks, trousers, handkerchiefs) took 40 minutes to dry at the "wash and wear" setting and used 2.6 kWh. (Wet weight 10 lbs - dry weight 6.75 lbs = 3.25 lbs water removed.)
- 6.6 pounds of thick towels took one hour to dry at the hot setting and used 3.4 kWh. (Wet weight 12.3 lbs - dry weight 6.6 lbs = 5.7 lbs water removed.)

Based on a theoretical calculation for the vaporization of water, it should take 0.73 kWh to remove one kilogram of water. Averaging the above three experiments it took 1.52 kWh to remove one kg of water. Therefore, 52 percent of the energy input was dissipated as waste heat.

Obviously, it takes a significant amount of energy to heat up the dryer (0.3 kWh). Part of this heat can be saved each time by doing one load immediately after another. Note that most dryers have a cool-down cycle. In order to save the heat for the next load the dryer needs to be shut off before the cool down begins.

Sort the laundry so that quick drying items such as "permanent press" shirts and sheets are together. The "permanent press" load used almost one kWh less than the mixed load and 50 percent less than the load of towels.

The heavier the clothes the greater the amount of water they hold and the more energy it takes to remove it. Therefore, be sure that the washing machine goes through the complete spin cycle before clothes are placed in the dryer. A complete spin cycle in the washing machine measured less than 0.1 kWh.

These strategies do help but only save a small percent of the total energy used in residences. There is cause for concern when one takes into account all of the waste heat that is vented outside. With space heating the number one energy user in residences, it is important for engineers to design some practical ways for recovering dryer waste heat for household heating purposes. Alternatively, dryer heat recovery (about 50 percent of the heat is lost) may be feasible as a method of increasing dryer efficiency.

Electric Dishwashing

Dishwasher energy use was monitored during the wash and dry cycles in order to discover opportunities for more efficient use of energy.

The dishwasher in this study was a 1973 model rated at 1.15 kW. It does not contain a water heating element. The full wash cycle uses 51 liters (13.5 gals) per load and requires 0.125 kWh (25 min at 5 W/min). The pre-wash cycle uses 21 liters (5.5 gals) per load and requires 0.035 kWh. During the dry cycle, 0.45 kWh are required (25 min at 18 W/min).

By eliminating the dry cycle the consumer can save 162 kWh per year or \$8. By eliminating the pre-wash an additional 12 kWh can be saved, but more importantly, approximately 6800 liters (1800 gals) of hot water per year can be saved.

$$\frac{(1800)(8.3\ \text{lbs/gal})(1\ \text{Btu/lb/°F})(80°\Delta t)}{0.8\ \text{efficiency}}$$

$$= 1.57\ \text{GJ}\ (1.49\ \text{MBtu})$$

Eliminating the pre-wash saved approximately 1.6 GJ (1.5 MBtu) natural gas or 440 kWh of electricity per year for water heating. In dollars this amounts to \$3 saved on natural gas or \$22 saved if water is heated electrically.

Energy Use in Clothes Washers

A 1965 washing machine with a 68 ℓ (18 gal) tub capacity was used in this study. A watt hour meter was read during a typical eight minute load. Hot water energy use was determined by reading the gas meter before and after a hot water wash and warm water rinse and by calculations based on the following equation:

$$\frac{(\#\ \text{gal})(8.3\ \text{lbs/gal})(1\ \text{Btu/lb/°F})(\Delta t)}{0.8\ \text{efficiency}}$$

where Δt is 140°-60° or 80°F

Electricity use for washing was determined to be 155 watt hours per load. During the eight minute wash and two minute deep rinse, 72 watt hours were measured. Drain and spin time lasted a total of 13 minutes and measured 82 watt hours. Each additional minute of washing time is 7.2 watt hours. This summarizes all of the energy used during a cold water wash.

A hot water wash uses 68 ℓ (18 gal) of hot water in the wash cycle plus 34 ℓ (9 gal) of cold water in the rinse cycle. This is equivalent to natural gas usage of 23 MJ or 22 kBtu per load. If the water heater were electric, 6.5 kWh per load would be needed--more than a 14 ft^3 refrigerator uses in a day.

If three loads per week were changed from hot water to cold water, the resulting yearly savings would be 3.7 GJ (3.5 MBtu) or $7 per year. With an electric water heater, 1,024 kWh or $50 would be saved.

Converting all washing to cold water (assuming an average of five loads per week) would save 6.1 GJ (5.8 MBtu) or $12 per year. With an electric water heater, savings would be 1,700 kWh or $85 per year.

RECOMMENDATIONS

The family of four described in this study reduced energy use significantly by using the following energy management practices. First, operational strategies were developed to use appliances more efficiently. This required no capital investment. Secondly, on-site modifications were made, such as delamping and adding insulation. This required a modest capital investment. Finally, by the purchase of new energy efficient equipment, such as a microwave oven and fluorescent lamps, additional energy savings were realized. This required a larger capital investment but resulted in additional energy savings.

Household electricity use, as compared with use before the 1973 oil embargo, was reduced to 56 percent and natural gas use was reduced to 60 percent. Some of these results were reported previously in a 1975 study (Reference 2). Additional savings have been realized since the earlier study due to the addition of water heater insulation and implementation of new operational strategies (see Figure 1).

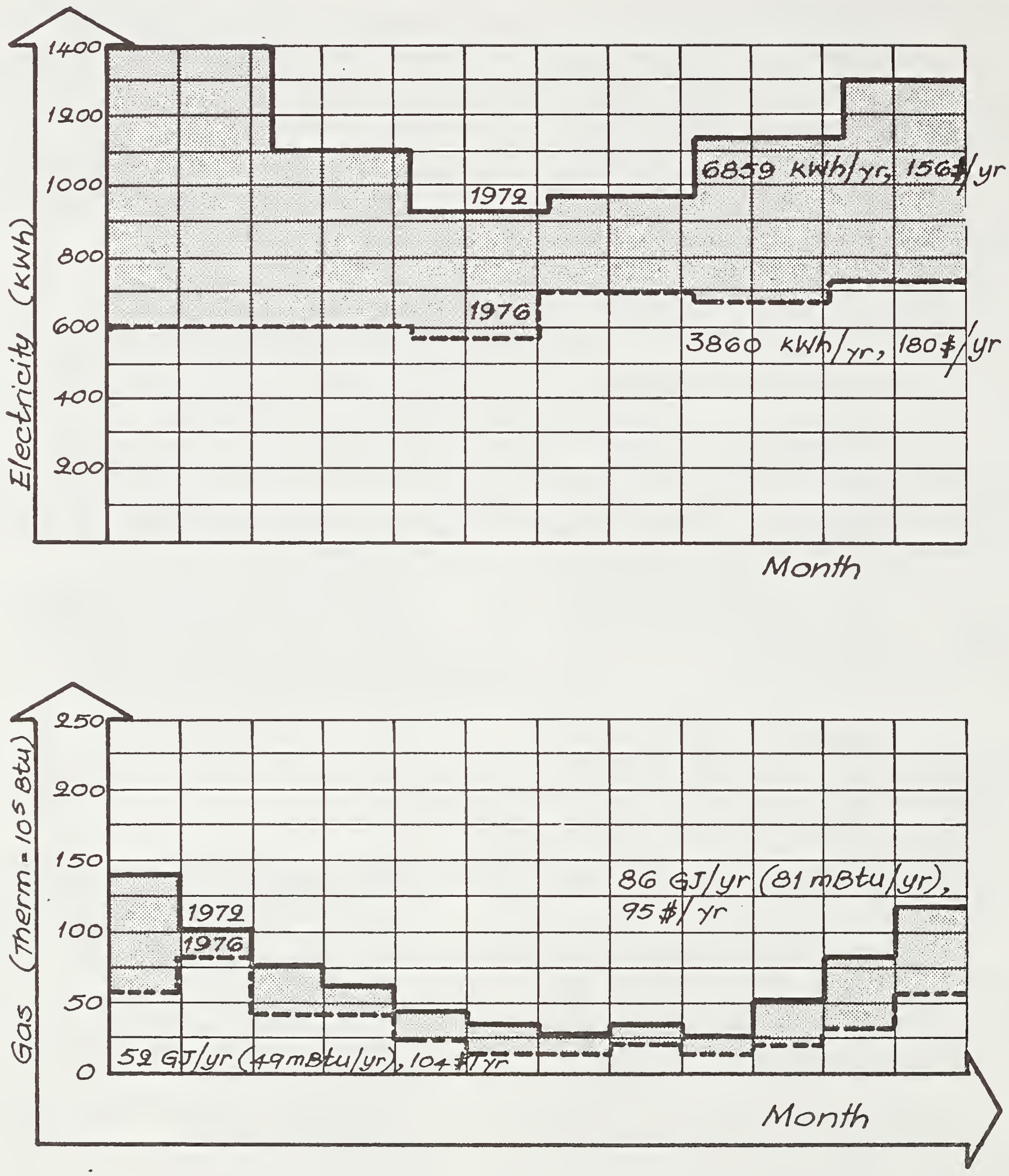
The total estimated savings are $200 per year. Seven hundred dollars were invested. This yields a 3.2 year payback. The results are summarized in Table 3.

References

1. Association of Home Appliance Manufacturers, *1976 Directory of Certified Refrigerators and Freezers*, Edition 1, (Chicago, Illinois: January 1976).

2. Smith, Nancy J. and Smith, C.B., "Direct and Indirect Use by Metropolitan California Families," in *$Q=E^3$ The Future is Now, Greater Los Angeles Area Energy Symposium*, Los Angeles Council of Engineers and Scientists, Proceedings Series, Volume 1, pp. 11-27, A.D. Emerson, ed., (North Hollywood, California: Western Periodicals Company, 1975).

3. Smith, Nancy J., "Energy Management and Appliance Efficiency in Residences," *Energy Use Management, Proceedings of the International Conference*, (New York: Pergamon Press, 1977).



HOUSEHOLD UTILITIES FIGURE 1

ENERGY MANAGEMENT PRACTICE	CAPITAL COST $	YEARLY SAVINGS energy	$	PAYBACK YRS.
1. Install R-11 insulation in attic and lower thermostat to 68°F.	150	220 therms	46	3.3
2. Insulate water heater with R-11 insulation.	10	100 therms	21	0.5
NATURAL GAS SAVINGS	160	320 therms	67	2.3
3. Change 1/2 of lighting load to fluorescent, delamp, install separate switches.	220	1,440 kWh	72	3.0
4. Purchase microwave oven and use extensively.	300	600 kWh	30	10
5. Disconnect electric heaters in bathrooms.	20*	500 kWh	25	0.8
6. Eliminate dry cycle on dishwasher.	-	160 kWh	8	-
7. Miscellaneous: unplug TV cable, use appliances more efficiently, turn off unnecessary lights.	-	300 kWh	15	-
ELECTRIC SAVINGS	540	3,000 kWh	150	3.6
TOTAL INVESTMENT, SAVINGS AND PAYBACK	700		217	3.2

*labor cost
prices based on 5¢/kWh and 21¢/therm (2.10 $/MBtu). Note that 1 therm = 10^5 Btu.

RESIDENTIAL ENERGY MANAGEMENT OPPORTUNITIES TABLE 3

FACT SHEET

UNITED STATES DEPARTMENT OF AGRICULTURE

ENERGY CONSERVATION IN THE RURAL HOME

Weatherize Your Mobile Home To Keep Costs Down, Comfort Up

The cost of operating your mobile home affects your budget. The comfort level affects your health. These are major considerations as you look for ways to save energy in heating and cooling it.

Heat is lost from your mobile home through ceilings, floors, windows, and walls. More than half of this loss is through ceilings and roofs. Ten to 20 percent is through floors. Windows and doors lose heat through conduction. Infiltration of air through cracks and holes robs you of still more heat. In the summer you lose air conditioning comfort in the same ways as heat is lost in the winter.

Look For The Label

If your home was manufactured before mid-1976, check the main places where heat is lost. If the manufacturing date is later, look for an indication (a label permanently attached on an interior wall) that it was built according to *Mobile Home Construction and Safety Standards issued by the U.S. Department of Housing and Urban Development (HUD), effective June 15, 1976.* A mobile home built according to the HUD standards meets basic requirements for condensation control, air infiltration, and thermal insulation (in the ceiling, walls and floors). Some homes exceed minimum HUD performance standards for thermal protection and are labeled as "Energy Conserving Homes." They receive a HUD heating and cooling certificate. If you find nothing to indicate thermal protection, then retrofit (winterize) the mobile home yourself.

Locate For Safety and Warmth Or Shade

How your home is placed (oriented) on its site will determine its comfort and safety. First, locate your home to protect it from strong wind. Second, take advantage of the sun's warmth in cold climates or of shade in hot zones. Come as close as you can to these suggested ideals:

1. If wind safety permits, locate the long sides of the home to face north and south. Otherwise, the home will be warmed unevenly, and light coming through west windows will be a problem.
2. Face kitchens east, or at least not west.
3. Windbreaks are needed most along north and west sides. Use something like:
   - a semi-enclosed carport
   - large evergreen shrubs
   - evergreen trees that hold their lower limbs
   - a tall fence
4. Shade the south side in summer by using:
   - awnings
   - porches
5. Plant deciduous trees on the east, west, and south sides of the home.

With the home properly sited and placed on a firm foundation, tie it down carefully. Use the straps the manufacturer supplies, or secure the home with the correct number of over-the-top straps. Anchoring specifications are readily available from dealers, installers, or the Cooperative Extension Service in your county. Shortcutting this step endangers the lives of family members and leaves the home vulnerable to being wrecked by windstorms.

Insulation

First, insulate overhead, where the greatest heat loss occurs. A urethane foam material 3 or more inches in thickness may be sprayed (on the roof only) and then topcoated with a protective liquid glass sealer to prevent discoloration and deterioration.

Cooling comfort can be increased through the use of cool seal reflective roof coating. This thick fiberous substance contains aluminum particles that migrate to the surface as the coating dries. A good thick coating is needed.

A note of caution; check the original coating material on your roof. Foam insulation will not stick to some coatings and an insulated false roof will have to be constructed in those instances.

Second, install fiberglass batts beneath the floor. Buy batts with a vapor barrier and place the vapor barrier toward the inside of the home. Keep the batts in place by

attaching chicken wire to the joists. Use the R-values of insulation recommended by your power company or the Cooperative Extension Service in your county.

Weatherstripping and Caulking

Weatherstripping and caulking are next.

Put weatherstripping around all windows and outside doors, filling in cracks. Double check the threshold portion of outside doors. Don't leave a crack between the bottom of the door and the threshold. Wear sometimes causes a crack to develop.

Caulking requires detective work. Air leaks and cracks not only increase the cost of heating and cooling, they let in damaging moisture. Check carefully around moldings, joints, nails, screws (especially in the siding panels), splash panels, windows, top seams, doors, roof vents and wheel housing. Seal all openings each year with a quality caulking compound. You can buy caulking in a variety of colors to match exterior colors. Use roofing cement on roof seams and around roof vent stacks.

Storm Windows

You can add an extra layer of protection to windows simply by taping a layer of 4 to 6 mil polyethelene over them. This is transparent "builders plastic." Use pressure sensitive masking or duct tape and place it along the entire clean edge on all four sides. This extra layer is useful even with storm windows; it adds the effect of triple glazing.

Skirting

If you have never gotten around to skirting or underpinning your home, do that, too. Skirting cuts drafts, aids insulation, and keeps high winds from producing an uplift effect on the home that can be damaging and dangerous. You can use corrugated metal or plastic as well as concrete blocks or brick.

Temporary skirting with hay bales or bagged leaves causes problems, for they may shift accidentally and close up necessary vent spaces. They are also a fire hazard since they ignite easily. It is better to use a more permanent noncombustible material. If the home has an underfloor burner for heating air or water, be sure that adequate openings are left in the skirting to supply fresh air for combustion.

About six 8- by 16-inch vents should be placed in the skirting to allow ventilation. One on each end, two along the front, and two along the back sides will probably do an adequate job. A panel should be built to maintain equipment underneath the mobile home. Vents should be placed no closer than 4 or 5 feet to a water line, but one vent should be placed as near as possible to the air intake of the furnace. Exposed water pipes—especially hot water pipes—should be wrapped with pipe insulation that is fitted and taped carefully over the full length of the exposed area. If heating ducts beneath the floor are not insulated, they should be. Use a minimum R-4 special duct insulating blanket and tape it in place.

The Thermostat

Reducing thermostat settings can save as much as 3 percent of fuel costs per degree Farenheit. Try these:

Heating Season
65° - 68° F
Adjust downward 5° - 10° at night

Cooling Season
10° F below outside temperature but no lower than 78° F.

If winter humidity can be controlled—try for a 50 percent humidity level. Keep it low enough to avoid window condensation problems. A little moisture can be added in the winter by carefully placing pans of water throughout the house for evaporation, but a furnace humidifier gives the most satisfactory results.

Maintenance

Take all the measures we have just discussed. Then carefully and systematically check item at least once a year.

Prepared by

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Fact Sheets In The Home Weatherization Sheets

1. Why Weatherize Your Home?
2. How To Determine Your Insulation Needs
3. Save Heating And Cooling Dollars With Weatherstripping And Caulking
4. How To Save Money With Storm Doors and Windows
5. What To Look For In Selecting Insulation
6. How To Install Insulation For Ceilings
7. How To Install Insulation For Walls
8. How To Install Insulation For The Floor And Basement
9. Solving Moisture Problems With Vapor Barriers And Ventilation
10. Weatherize Your Mobile Home To Keep Costs Down, Comfort Up
11. Tips On Financing Home Weatherization
12. Keeping Home Heating And Cooling Equipment In Top Shape
13. Landscaping To Cut Fuel Costs
14. Home Management Tips To Cut Heating Costs
15. Locating New Home Sites To Save Fuel

Single copies are available upon request to Special Reports Division, Office of Governmental and Public Affairs, U.S. Department of Agriculture, Washington, D.C. 20250.

This series of fact sheets was assembled from research, Extension and other sources by the USDA Task Force on Weatherization.

Cooperative Extension Service

University of Arkansas Division of Agriculture and United States Department of Agriculture, Cooperating

ENERGY $

ENERGY CONSERVATION IN YOUR MOBILE HOME

Mrs. Eleanor J. Walls
Extension Specialist - Family Housing

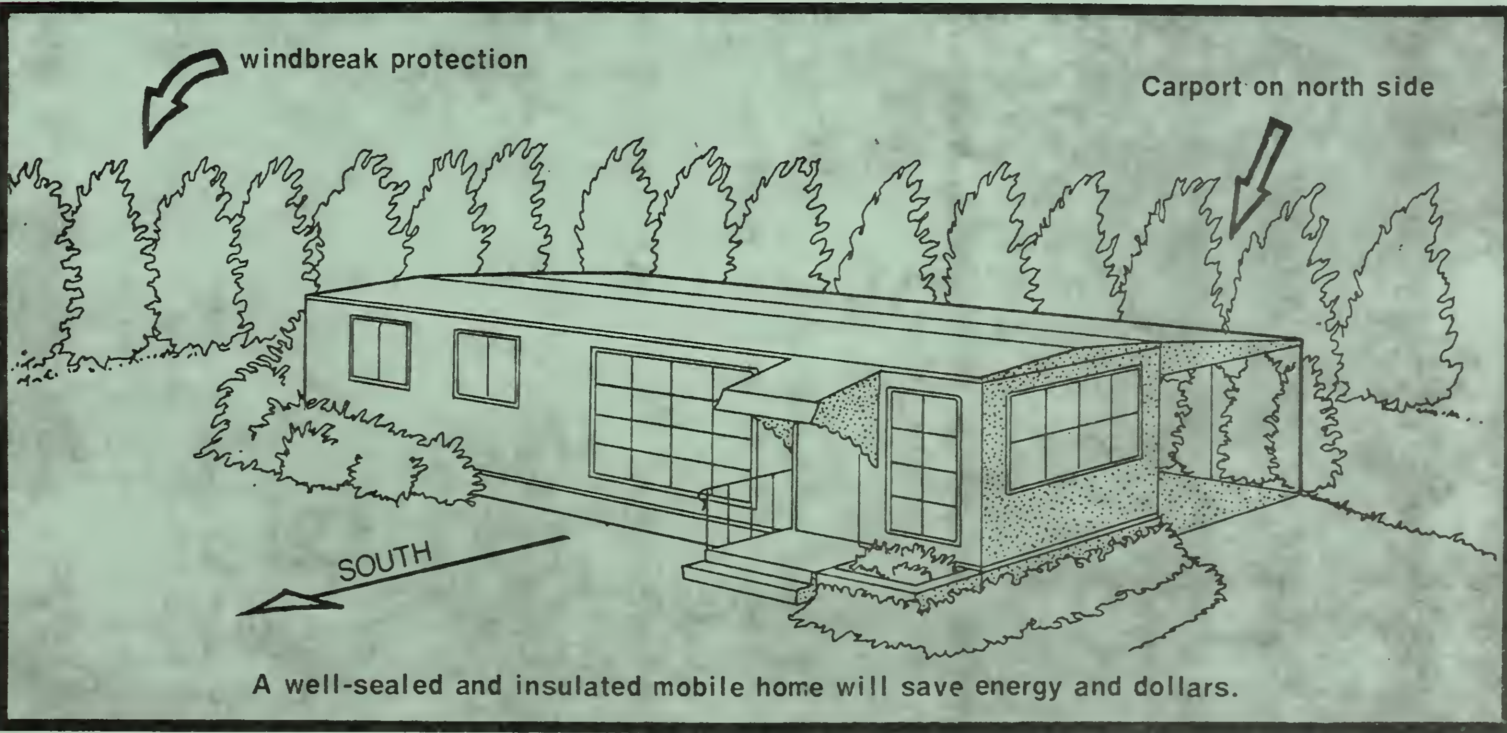
With declining energy resources and increasing costs facing us, the need to conserve energy is pressing. This need applies equally to occupants of houses, apartments, and mobile homes.

Whether you already own a mobile home or are considering the purchase of a new one, there are several steps you can take to save energy and dollars and, at the same time, make your home more comfortable.

PURCHASING A MOBILE HOME

When you purchase a new mobile home, buy according to Mobile Home Construction and Safety Standards issued by the U.S. Department of Housing and Urban Development (HUD), effective June 15, 1976.

A mobile home built according to Subpart F of the HUD standards meets basic requirements for condensation control, air infiltration, thermal insulation (in the ceiling, walls, and floor) and has a label permanently affixed on an interior wall certifying according to climatic conditions the capability of heating and cooling equipment. The standards are the result of research by mobile home manufacturers and insulation engineers. A home insulated to HUD's performance standards is more comfortable in winter and summer and is



A well-sealed and insulated mobile home will save energy and dollars.

more economical to operate than a home with less thermal protection.

Some mobile homes manufactured in Arkansas today exceed minimum HUD performance standards for thermal protection and are labeled with "Energy Conserving Home" tags, as well as HUD heating and cooling certificates. You can expect even greater comfort and economy of operation from them.

SITING AND SHADING

Much of the comfort you expect in your mobile home and the home's efficient use of energy is determined by its placement or siting. Site a mobile home so that the long sides face north and south. This will give maximum protection from the sun. Protect your home against prevailing winter winds by building a semi-enclosed carport or by planting a windbreak of evergreens along the north and west sides of the home. A tall fence can also be used as a windbreak.

Well-planned awnings or porches on the southern side, deciduous trees on the east and west sides, wind protection on the north, and shrubs planted along the mobile home skirt will all help to protect the structure from summer sun and winter winds. Another important consideration would be to site your home so that the kitchen area *does not* have a western exposure.

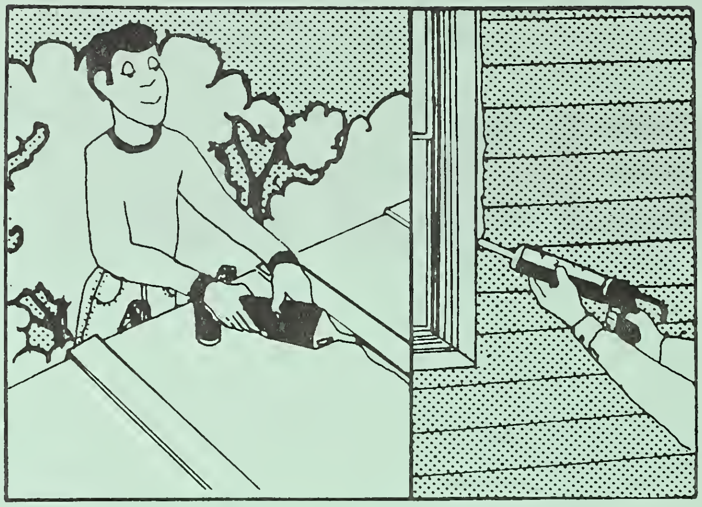
SKIRTING

Full and properly installed skirting on a mobile home acts as added insulation and helps to reduce energy use. Vents should be provided to allow for air circulation, thus preventing moisture accumulation, and for the heating system's air combustion intake. The mobile home space should be properly graded for water runoff.

ROOF COATING

There are several brands of mobile home roof coating, a synthetic weatherproof coating which you can apply by brush or roller. This coating helps protect your roof from the elements and reflects the sun — which keeps your mobile home cooler in the summer, thus reducing your electric bill. For maximum effectiveness, coat (or paint) the roof every year. A special conditioner should be used on cracks and breaks before applying the protective coating.

CAULKING AND WEATHER STRIPPING



Caulking the roof and windows reduces air leakage.

Air leaks and cracks, however small, increase the cost of heating and cooling a home and can result in moisture entering and damaging the structure. Check your home carefully for cracks and openings around the moldings, joints, nails, splash panels, windows, top seams, doors, roof vents, and wheel housings. Using a caulking gun or putty knife, plug and seal all openings with a quality caulking compound. The best compounds remain elastic when dry and are available in an array of colors to match exterior finishes. Thorough weather stripping around windows and doors will also cut heat losses.

PLASTIC STORM WINDOWS

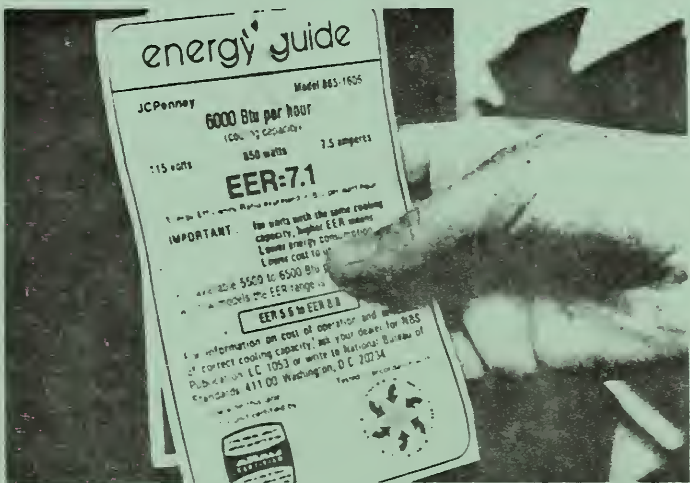
The 1976 HUD standards require storm windows or insulating glass in mobile homes. If storm windows are not available for your present mobile home, or even if you have them, the installation of 4- to 6-mil plastic sheeting over windows will reduce heat loss. You may want to leave one or two windows on the south side of the home uncovered so they can be opened on a warm day. Plastic sheeting can be held in place with masking or pressure-sensitive tape and removed at the end of the heating season.

AIR CONDITIONING

If your mobile home is equipped with an automatic cooling system, set the thermostat no lower than 78°-80°F. Have the cooling system checked annually by a serviceman.

If you use a room air conditioning unit, be sure to choose one which is the right size for your mobile home. An air conditioner which is the proper size cools, dehumidifies, and provides more consistent comfort with greater efficiency.

Before buying a room air conditioner, check the Energy Efficiency Ratio (EER) found on the Energy Guide Labels. The higher the EER number, the more efficient the air conditioner and the less it costs to operate compared to units of similar cooling capacity. For room air conditioners, the EER ranges from about 4 to 12. An air conditioner with an EER of 10 will provide the same amount of cooling with half the electricity as one with an EER of 5. Very often, a unit with the highest EER rating will cost more to buy, but will save you money in the long run because it uses less electricity.



The Energy Efficiency Ratio (EER) helps determine the air conditioner's efficiency.

HEATING

Mobile home electric, gas, and oil heating systems are fully automatic. An electric system will likely be one of two types. The first is individual electric baseboard heating units which are generally controlled by individual room thermostats, permitting separate temperature regulation for each room. The second is an electric resistance heating system which operates in the same manner as a gas or oil furnace.

For all types of heating systems, set the thermostat no higher than $68^{o}F$. Be sure you do not block the furnace's fresh air intake, outside draft opening, or inside outlets. You should also follow carefully the lighting, operating, and maintenance instruction booklets supplied by the manufacturer.

Heating ducts are often located underneath a mobile home. This causes excessive heat loss. Cover all exposed ducts with a minimum of R-4 insulation.

An annual check by a qualified maintenance person will help keep your heating system operating at maximum efficiency.

Exhaust fans in the kitchen and bathrooms are useful for venting excess moisture, but use them sparingly.

For more information about energy conservation contact your county Cooperative Extension office.

Source: "Conserve Energy in Your Mobile Home," Cooperative Extension Service, Cornell University, Ithica, New York.

"Conserving Energy in Your Mobile Home," Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Florida.

EJW:pm
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Extension
Home
Economics

EXTENSION
ENERGY CONSERVATION

COOPERATIVE EXTENSION SERVICE/UNIVERSITY OF GEORGIA COLLEGE OF AGRICULTURE/ATHENS

Energy Conservation In Mobile Homes

The need to conserve energy is increasing in importance as energy and consumer resources decline. Conservation begins at home -- the mobile home, that is. And when you save energy in the mobile home, you also make it more comfortable.

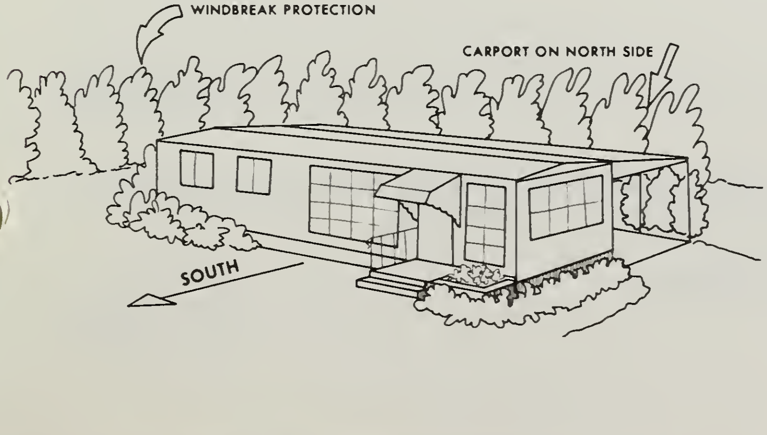
Buying a Mobile Home

Looking for a new mobile home? Make sure it's made according to the latest Mobile Home Construction and Safety Standards issued by the U.S. Department of Housing and Urban Development (HUD). These regulations set basic requirements for condensation control, thermal insulation, and air infiltration. A label placed on an interior wall certifies the performance capability of heating and cooling equipment.

Some mobile homes are built according to ANSI (American National Standards Institute) standard A119.1, and may exceed minimum HUD standards. Some bear the label "Energy Conserving Home" and also have HUD heating and cooling certificates. These models contain more insulation than is required to meet performance standards, and will reduce your heating and cooling costs.

Site Selection

Much of the economy and comfort in a mobile home is determined by its placement on the site. If possible, place the long axis of the structure in an east-west orientation so that the long walls do not receive intense sunlight or bitter winter winds.



Use sun roofs, carports, window awnings, and other horizontal projections to reduce glare and heat absorption on walls and windows. Tall deciduous trees on the east, south, and west of your mobile home will provide summer shade and serve as a windbreak in winter. Because cooking can overheat a kitchen, this room should not have a west exposure where it can absorb heat from the afternoon sun.

Cooling

Air conditioner thermostats should be set at 78° - 80°F., operated according to the manufacturer's suggestion and be checked annually by an experienced serviceman. A properly sized air conditioner cools, dehumidifies, and provides more comfort with greater efficiency.

Before buying an air conditioner, check the Energy Efficiency Ratio (EER) found on the label. EER ranges from about 4 to 12. The higher numbers give more cooling for the energy used. An air conditioner with an EER of 10 will provide cooling with half the energy of one with an EER of 5. The units with higher EER will often cost more to buy but will be cheaper in the long run because they use less energy.

Heating

Electric, gas, and oil systems in most mobile homes are fully automatic. Most mobile homes use gas heat. However, some use electric systems that may be of two types. The first uses electric baseboard heaters, which are generally controlled by individual room thermostats. The second is an electric resistance heating system which operates in the same manner as a gas or oil furnace. Do not set thermostats higher than 68°. Keep all air intake and outlets open and follow the instructions provided by the heater manufacturer.

Skirting

Full and properly installed skirting on a mobile home serves as additional insulation and helps reduce energy use. Install vents to provide controlled air circulation and prevent moisture accumulation. Skirting can also provide combustion air for the heating system.

Shrubs which shade the skirting can reduce the temperature under floors in summer and act as added windbreaks in winter.

Insulation

How do you add insulation to the floors and roofs of mobile homes? Try spraying a urethane material on the roof to the desired thickness; it should be coated with a protective sealer to prevent deterioration and discoloration. Glass fiber batt insulation may be installed under the floor and held in place with a wire mesh stapled to the surface.

Weather Stripping

Air leaks and cracks increase the cost of heating and cooling a home. Check your home carefully for cracks and openings around mouldings, joists, nails, splash panels, windows, top seams, doors, roof vents, and wheel housings. Various weather stripping materials are available to cover these cracks and openings.

Storm Windows

Storm windows reduce home heating and cooling requirements by 10 to 13 percent. If an owner in Central Georgia allows for increases in the cost of energy, he can expect to recover the cost of adding windows to his centrally heated and cooled mobile home in about five years. The recovery time for expensive fuels is five years; cheaper fuels give a faster rate of return.

Need a low-cost cover for storm windows? Try plastic; it can be secured with pressure sensitive tape.

Temperature Control And Ventilation

Lower the thermostat setting during the heating season. Use exhaust fans to remove moisture from steamy kitchens and bathrooms.

By insulating the structure and utilizing the equipment in a mobile home, you can increase its energy efficiency.

Prepared by Cecil Hammond, Extension Engineer

Grateful appreciation is expressed to the Georgia Department of Energy Resources for contributions made toward the printing of this material.

H & E 4

Miscellaneous Publication 59 April, 1978

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, the University of Georgia College of Agriculture and the U.S. Department of Agriculture cooperating.

Tal C. DuVall, Director

Cost $306.25
Quantity 20M

CONSERVATION IN BUILDING PLANS AND SPECIFICATIONS

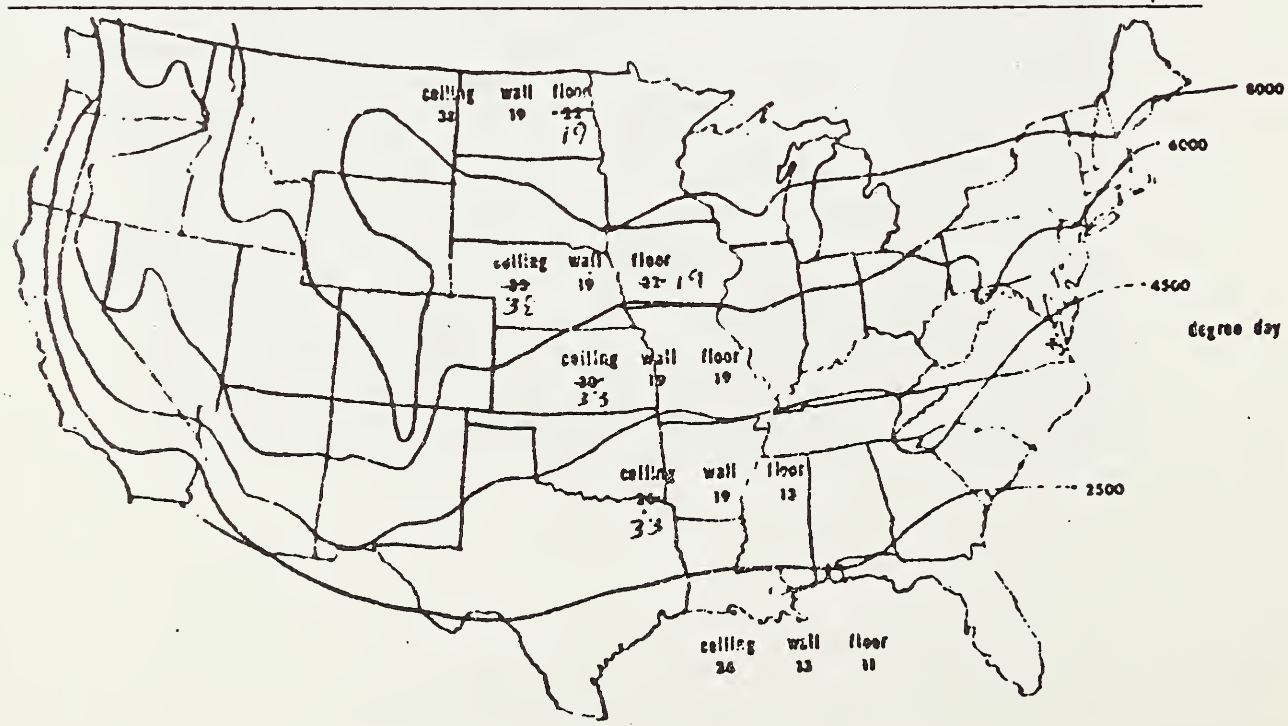
REA Bulletin 86-4, "Presentation of Building Plans and Specifications," will be revised to include guidelines for energy conservation design. The following are the proposed guidelines presently being considered:

A. No new building should be planned without giving careful consideration to solar energy. Because of the energy situation and because fuel costs are rising rapidly, the use of the structure as a solar collector and heat trap becomes a major design consideration. Structure siting, orientation, insulation and thermal mass should all be considered by the designer. The building should be a passive solar collector; if practical, it should be a high thermal mass heat trap; it should be oriented and sited for installation of an active solar system, whether or not an active system is initially installed.

   Evaluations of active thermal solar options (space heating and cooling, and water heating) should be based on long-term economic considerations including anticipated increases in fuel costs. The opportunity and need to play an important solar demonstration role within the community should also be considered. Borrowers who are planning new or extensively remodeled headquarters facilities have a unique opportunity in this regard. REA believes that if full and careful consideration is given, a considerable percent of new structures will include active thermal solar systems for water heating, and in some cases for space heating or cooling. Borrowers are cautioned, however, to utilize the services of a firm having knowledge and capability in energy conservation and passive architectural considerations and, as appropriate, in the area of active solar systems. Because of the investment needed for an active solar system, there is no room for mistakes. The system, including all components (collector, heat transfer medium, pumps, piping, controls, gasketing, etc.) should be of proven performance. The equipment, as well as the necessary system design and installation technology, is available. It is only necessary to be certain that the consultant has the knowledge, experience, and capability to provide an effective long-lasting system.

B. Except where reliable studies show that reduced building insulation will result in less energy use, REA <u>strongly recommends</u> that normally heated or air-conditioned areas such as offices, lobbies, meeting rooms, office buildings, etc., be provided with the following minimum values of thermal insulation.

Winter Degree Days	Ceilings U	Ceilings R	Walls U	Walls R	Floors U	Floors R	Slab Edge U	Slab Edge R	Glazing
2500 or less	.038	26	.077	13	.09	11	None	None	Single
2501 to 4500	.03	33	.05	19	.077	13	.20	5	Double
4501 to 6000	.03	33	.05	19	.05	19	.13	7.5	Double
6001 to 8000	.026	38	.05	19	.05	19	.13	7.5	Double
8001 or more	.026	38	.05	19	.05	19	.10	10.0	Triple



In buildings, where mass will significantly increase building energy efficiency, REA has no objective to nominal reduction in these R values.

Compliance with the above insulation provisions should be required by and shown on the plans and specifications. The "U" values may be obtained with any acceptable material(s) and/or structural system; however, reliance on air space in walls is not recommended.

C. Where efficiency indices such as "COP" or "EER" are applicable to the heating or air conditioning equipment to be obtained, the minimum acceptable indices at standard rating conditions should be stated in the specifications. Following are various recommended minimum indices. Depending on competitive conditions, especially as more energy efficient equipment becomes available, it will probably be economically advantageous to specify more efficient equipment than indicated below. The architect should also consider requiring more efficient equipment in cases where he is aware of adequate competition in supplying such equipment. Heat pumps presently becoming available have cooling EER ranging from 9.5 to 10.0 and heating COP from 3.4 to 4.0. The availability of this high efficiency equipment should be investigated and, if practical, specified.

Recommended Minimum COP for Heat Pumps (Heating Mode)

Source and Outdoor Temperature	"COP"
Air Source - $47^{o}F$ db/$43^{o}F$ wb	2.5
Air Source - $17^{o}F$ db/$15^{o}F$ wb	1.5
Water Source - $60^{o}F$ Entering	2.5

Recommended Minimum EER (Coolings) for Electric HVAC System Equipment

Item	"EER"
Air Entering Equipment - $80^{o}F$ db/67^{o} wb	
Condenser Ambient (air cooled) - $95^{o}F$ db/$75^{o}F$ wb	7.5
Condenser Water (water cooled) - $85^{o}F$ Inlet/$95^{o}F$ Outlet	7.5

Recommended Minimum COP* for HVAC System Heat Operated Cooling Equipment

Heat Source	"COP"
Indirect-Fired (Steamy Hot Water)	0.68
Direct-Fired (Gas, Oil)	0.48

Recommended Minimum COP* for Electrically Driven HVAC System Components (Cooling)

Component	Condensing Means	"COP" Air	"COP" Water	"COP" Evaporator
Self-contained Water Chillers	Centrifugal	2.3	4.0	
	Positive Displacement	2.2	3.4	
Condenserless Water Chillers	Positive Displacement	2.8	3.4	
Compressor and Condenser Units	Positive Displacement	2.5	3.5	3.5

*At Standard Rating Conditions per ASHRAE Standard 90-75

D. Heating, ventilation and air conditioning systems should be planned for efficient operation for the type of expected use. The hours of operation at full load and at various part loads (operation of systems and components) should not be ignored in studies and projections of building energy use. Where appropriate, an economy cycle should be considered so that outside air can be used to provide cooling to the extent possible. Also, consideration should be given to the possibility of reclaiming excess heat from one part of a building for use in providing heat in other parts of the building. Decisions regarding the type of system, economy cycle, heat reclaim system, etc., should be based on long-range economic evaluations rather than simple first cost comparisons.

E. Lighting accounts for approximately 20% of the "electric" and 5% of the "total" energy consumed in the United States. For this reason, REA recommends that borrowers and their architects give consideration to the use of daylighting and energy efficient artificial lighting systems in the design of headquarters facilities. Significant energy savings are also possible by relamping existing installation with more efficient sources of illumination.

1. Natural Lighting Systems: The amount of daylight that can be effectively introduced into a building is related to the design and orientation of the facility. Because of this, the borrower and architect should study the proposed project to determine whether a natural lighting system, supplemented by artificial illumination, is a cost effective alternative. In making this determination, all the possible costs and benefits associated with a natural lighting system should be evaluated.

2. Artificial Lighting Systems: Presently, there are several artificial lighting systems in common use ranging from the most efficient, high pressure sodium, to the least efficient, the incandescent. Table I outlines the relative efficacies of the various systems. This data should not serve as the sole basis for the selection of a particular lighting system since other factors such as task performance, visual characteristics and total cost may influence system selection. However, this information should provide some general guidance in the development of a lighting scheme for new headquarters or the relamping of existing ones.

TABLE I

Efficacies of Artificial Light Sources

Type of Artificial Lighting System	Range of Efficacies* (Lumens/Watt)
High Pressure Sodium	84-126
Metal Halide	67-93
Fluorescent	66-70
Mercury	44-57
Incandescent	17-24

*Includes ballast losses.
**There is overlapping of efficacies between different lighting systems and sometimes within a given lighting system for different wattage and life ratings.

Since artificial lighting systems can be used to replace or modify existing systems, borrowers may be able to realize significant savings by replacing less efficient sources with more efficient ones. Table II gives some general examples of the savings possible by relamping. The important thing to remember is that these kinds of savings are available to all borrowers and not just those considering the construction of new headquarters facilities.

TABLE II

Savings Possible by Relamping

Application 1: Office Lighting (2,700 Hours Use Annually)	Annual Savings Energy (kWh)	Dollars ($)* At 3¢/kWh	At 5¢/kWh
Existing Installation (Changed To) New Installation			
1 - 300 Watt Incandescent -- 1 - 100 Watt Mercury Vapor	486	14.58	24.30
2 - 100 Watt Incandescent -- 1 - 40 Watt Fluorescent	400	12.00	20.00
7 - 150 Watt Incandescent -- 1 - 150 Watt Sodium Vapor	2,360	70.80	118.00
Application 2: Industrial Lighting (3,000 Hours Use Annually)			
Existing Installation (Changed To) New Installation			
1 - 300 Watt Incandescent -- 2 - 40 Watt Fluorescent	623	18.69	31.15
1 - 1,000 Watt Incandescent -- 2 - 215 Watt Fluorescent	1,617	48.51	80.85
3 - 300 Watt Incandescent -- 1 - 250 Watt Sodium Vapor	1,806	54.18	90.30

*These figures represent annual energy savings only. Installation and maintenance costs are not included.

3. <u>Lighting Levels</u>: The ability of a person to perform specific functions (tasks) is related to the level of illumination present in the working environment. Table III contains REA recommended illumination levels for new or modified commercial (headquarters) facilities. These recommendations apply to the illumination level on the "work station" (the place where the task is actually performed) as opposed to the level of the "work area" which surround the work station and generally requires less illumination. To optimize energy utilization, REA recommends that this type of "nonuniform" illumination approach be used.

TABLE III

Recommended Lighting Levels

Task or Area	Illumination Level (Footcandles*)
Hallways or Corridors	10 ± 5
Work and Circulation Areas Surrounding Work Station*	30 ± 5
Normal Office Work (Task Only)	50 ± 10**

*footcandle = 1 lumen per square foot.
**prolonged or visually difficult tasks may require illumination levels above this guideline. In such cases, the additional illumination should be concentrated on the task itself and not the work station.

4. Practical Considerations in Lighting System Selection: In evaluating the relative merits of the various lighting systems available, some items to be considered are:

   - Is the system designed for the expected activity?
   - Are efficient light sources and fixtures utilized?
   - Is flexibility provided for controlling the system and its components?
   - Is daylighting used to maximum economic advantage?
   - Is lighting equipment easily cleaned and relamped?

Lighting is one factor that should be considered in headquarters construction. However, it is not the only factor. Whatever lighting scheme is decided upon must be consistent with the overall energy conservation package for the specific facility under consideration.

ENERGY CONSERVATION IN THE HEADQUARTERS BUILDING

Wharton County Electric Cooperative, Inc.
El Campo, Texas

By late 1973, it had become obvious that the cost of fuel for generating electricity was in an uncontrollable upward spiral, having more than doubled since the first of the year. We started looking around for ways to help our members conserve to hold down the cost of electricity. It seemed appropriate that we begin at home - our office building.

The office building, completed in 1970, contains 6,600 square feet of office space which is air-conditioned and heated; and 3,500 square feet of warehouse, with heating only. Heating is with electric heat strips. An additional warehouse of 7,500 square feet was added in 1975, which is neither heated nor air-conditioned. The original building in 1970 was built to construction and insulation standards commonly used at the time; those being minimum window space (grey plate plass was used), a 6" ceiling and 4" wall insulation.

After surveying the situation, the following changes were made during January, February and March of 1974:

(1) The air-conditioning system had been designed for the air-handlers to operate continuously. There wasn't even a switch to turn them off. Thermostats were replaced, providing for automatic operation with the air-handlers only operating when the compressor or heating elements are on.

(2) The air-conditioning and/or heating units were operating continuously, including nights and week-ends. This was changed with instructions that the units be turned off at night and week-ends; except in extremely hot weather, the thermostat could be set at 85 degrees during week-ends. This was to facilitate faster recovery on Monday morning.

(3) The building had five air-conditioning and/or heating zones. Each zone had sub-zones which would inject heat into the air-conditioning to stabilize temperature in all offices. Obviously, these heaters were disconnected.

(4) Instructions were issued that all office lights and rest room lights will be turned off when not occupied. Also, the lights in the halls and rest rooms were reduced by eliminating one-half of the fixtures. A minimum number of indoor lights are left on at night for security purposes; namely, indoor hall and lobby lights only. The front of the building was lighted by both flood lights and spot lights. The spot lights were removed.

(5) The rest rooms had exhaust fans that operated continuously. These were rewired through the light switches which are turned off when the rooms are not occupied.

(6) We had an outside 5 KW quartz heater above the drive-in window. Personnel were instructed to discontinue use of this heater. We had base board heating under our largest plate glass window section. This was made inoperable. Some sweating occurs on this window, but this is not of any major consequence.

(7) Instructions were issued that thermostats not be set below 77 degrees in the summer time, or above 73 degrees in the winter. Previously, everyone set thermostats for his own comfort. The recommended 68^{o} is not acceptable to these Southern thin-blooded people. We did, however, set the warehouse heating thermostats permanently at 65 degrees.

(8) The building contains a Community Room which is used frequently at night. Those using the room are now instructed very carefully in regard to the air-conditioning and heating system, and to turn the system off after their meeting.

Results have been astounding. From the accompanying charts, it can be seen that during the first year after improvements were made, kWH consumption was reduced by over 33 percent. A better comparison would probably be over a period of several years since annual weather changes would be minimized. This is even more phenomenal. As can be seen from the chart, efforts have amounted to almost 50 percent savings in kWH consumption.

The results of this endeavor is used to convince members that there are areas for conserving electricity if they will just look around and find them. It points up mainly the vast waste of energy in office buildings where comfort and ecstatic considerations often outweigh enonomic operating factors.

There is still room for improvement. For example: The building has a suspended ceiling, and the 6" of bat insulation lays loose on top with numerous gaps. We have contracted to have insulation blown in to double the "R" value of the present insulation. One problem that we encountered with this was the many fluorescent fixtures in the building. It is necessary to "box" around these to avoid being covered with blown insulation, thus creating excessive heat. There is also one roll-up door in the office area where excessive losses occur. We intend to replace this with Styrofoam-filled double doors. We also are considerting a vestibule, creating a double opening at the entrance. Thermostatically controlled exhaust fans in the roof for attic temperature control are under consideration.

WCEC - Annual kWh

YEAR	kWh Before Conservation	kWh After Conservation
1971	249,840	
1972	307,680	
1973	234,000	
1974		156,000
1975		141,240
1976		122,760
1977		121,680
	791,520	541,680
Avg./Yr.	263,840	135,420

%Reduction 48.6%

WCEC - Monthly kWh

	1973	1974
Jan.	32,280	21,120
Feb.	24,000	16,320
March	19,440	12,120
April	16,560	8,520
May	15,000	11,280
June	15,840	12,480
July	19,200	12,600
Aug.	20,400	12,960
Sept.	21,000	10,680
Oct.	17,400	9,600
Nov.	14,400	11,040
Dec.	18,480	17,280
Total for Year	234,000	156,000

%Reduction 33.3%

10/78

DAIRYMEN'S ENERGY CHECK LIST

1. WATER SUPPLY SYSTEM

*Possible energy savings 10-40%.
*Maintain your pumps at maximum efficiency.
*Have SDG&E test your deep well vertical turbine pump.
*Repair any leaking faucets or water lines.
*Take precautions to prevent water-logging in the supply tank of the pressure system. Frequent starting is detrimental to the motor and uses more power.
*Avoid excessive washing of cows. Put timer switch on pump control.
*Consider the possibility of reusing wash water.

2. HOT WATER HEATERS

*Possible energy savings up to 20%.
*Set thermostat no higher than required.
*Use no more hot water than is necessary.
*Purchase a water heater insulation blanket from SDG&E.
*Insulate hot water lines.
*Heat no more water than is needed in a specified period of time. If water use is infrequent and auxiliary tanks are being used to store hot water for peak use, investigate the possibility of using instantaneous for fast recovery water heaters. This will eliminate cooling off periods which can reduce efficiency by as much as 15% for electric and 20% for gas heaters.
*Where refrigeration units exist, investigate the feasibility of recovering heat from the refrigeration system to supply or supplement water heating requirements.

3. MOTORS

*Possible savings in electricity up to 5%.
*Shut off motor when not in use.
*Check wires to motors--should be adequate size. Heating of the wires usually indicates the wires are too small and energy is being wasted. Low voltage may also result, which can damage motors.
*Keep motors clean. Clogged air ducts retard ventilation and motors may overheat. This heating could lead to eventual burnout.
*Don't overload the motor.
*Match the motor load to the motor size. A motor running at half its rated load may lose ten or more percent in power factor. This increases current and power losses over that of a properly matched motor and load.
*Check and replace loose or worn-out fan belts.
*Motors with thermal overload protection should be used.

4. SPACE HEATING

*Insulate farm structures that are heated.
*Heat structures only when necessary and at no greater temperature than necessary.
*Use infrared heat rather than convected heat in open or semi-open structures where heating is required.
*Keep doors closed, weatherstrip doors, vents and fan openings.
*Use pipe insulation or aluminum faced building paper behind heat pipes to reduce radiation losses.

5. LIGHTING

*Possible savings in electricity up to 10%.
*Keep light bulbs and fixtures clean.
*Use the correct size lamps for the job.
*Turn lights off when not needed.
*Reduce lighting level where practical and safe.
*Consider replacement of incandescent lights with fluorescent lights. Fluorescent lights will give the same amount of light for one-third the power requirement.
*Use mercury vapor, metal halide or high pressure sodium vapor lights for necessary outside areas instead of large incandescent lamps.

6. EFFICIENT HEATING EQUIPMENT

*Possible fuel savings of 5 to 20%.
*Use thermostats with +/-1 degree F accuracy.
*Aspirate thermostats for more uniform control.
*Be sure that your burners are adjusted properly.
*Check the boiler, burner and back up system to make sure they are operating at peak efficiency.
*Boiler efficiency drops for both underloaded and overloaded conditions, so efficiency tests should be run annually.
*Boilers with aspirated fuel injection operate at about 80% efficiency, higher than most.
*Turbulators can let your boiler use up to 15% less gas or oil.
*Recuperators and heatmizers use waste gases from the boiler to raise the feedwater temperature with possible fuel savings opportunities of 5 to 10%.
*Clean heating pipes and other radiation surfaces often. Remove scale at recommended intervals and in a recommended manner.
*Use horizontal air flow or fan tube systems for more even heat distribution.
*Insulate distribution pipes in areas where heat is not required.
*Insulate the boiler itself if it isn't heating a work area.
*Check and repair leaks in valves or pipe.
*Ask SDG&E's Agricultural Representative for a copy of the Total Energy Handbook.

7. WIRING SYSTEM

*Possible savings in electricity of 1 to 4%.
*Have your wiring system inspected for overloading, corroded parts and faulty insulation.
*Losses of electric energy to heating of the wires can be reduced by using larger wire sizes.
*Ask SDG&E's Agricultural Representative for a copy of the Agricultural Wiring Handbook.

REA CONSERVATION NOTES - IRRIGATION

REA's conservation practices for irrigation pumping are outlined in the attachment "Recommendation as to Irrigation Practices" to Bulletin 145-1. The recommendations include (1) recommendations for the power supplier before extending service and (2) recommendations for the irrigator.

Irrigation is the application of water to land when precipitation is inadequate for optimum plant growth. By definition, therefore, the application of water is dependent upon the weather. Since the requirement for water is due to weather, the irrigation pumping plants places high seasonal capacity requirements (kW demand) on the system resulting in a low annual load factor type load on the system. The demand and energy requirements are so entwined that we cannot consider one and not the other.

Irrigation practices that have been accepted were dictated by economics and the information available to irrigators. Evidence indicates that this evolutionary process has, in many areas, resulted in overapplication of needed water by the irrigator. Another result affecting the irrigator has been insufficient attention to the wire to water efficiency of the pumping plant. Probably due to the price of energy, the irrigator did not necessarily request and/or obtain a pumping plant with good overall pumping plant efficiency. The process has also resulted in less than optimum attention by power suppliers to rates and system design, e. g., system loss, power factors, system capacity, adequate irrigation rates, and so forth.

The energy situation served to bring these problems into focus. Energy and water conservation practices have been and are being developed in the following ways:

1. Development and improvement of irrigation practices (such as scheduling) by the irrigator.

2. Improvement in water application efficiency as follows:

    a. Increased use of tailwater pits which returns water to the irrigation field with less energy requirements than the pump.

    b. Reducing conveyance losses of irrigation water by a better design of the irrigation system line, e. g., lining ditches with concrete, underground pipe, better design of irrigated farms, and so forth.

There is considerable load management now being practiced for irrigation pumping. This load management has been designed to reduce demand. An apparent unanticipated spinoff of some load management has been the reduction in the amount of water being pumped, forcing better irrigation practices on the irrigator, resulting in conservation of both water and energy.

There are several areas in which to work toward the conservation of energy and the reduction of capacity requirements of the power supplier.

1. Proper well development and testing to determine well characteristics.

2. Proper selection of pumping equipment for maximum overall pumping plant efficiency.

3. Use of sophisticated monitoring equipment by irrigators to match water application to crop requirements.

4. Reduction of total dynamic lift by improved system design of system, including use of low pressure sprinkler systems whenever possible.

5. Greater emphasis on overall pumping plant efficiency which might include a testing program by the power suppliers and assistance to determine when an irrigator should recondition or replace the pump.

6. Better design and operation of electric distribution systems to reduce line losses.

North Carolina Agricultural Extension Service

SYNERGY

Working Together for Energy Tomorrow

WOOD STOVE EFFICIENCY

Efficiency is an often misused term and may mean different things to different people.

There are many variables related to the combustion of wood, such as the quality of the wood and the combustion environment. Because of this, there are several types of efficiency ratings.

$$\text{Combustion Efficiency} = \frac{\text{Heat Energy Generated by Combustion}}{\text{Wood Energy Input}}$$

The method used to deliver the heat from the combustion chamber to the unheated space will greatly affect the quantity of available heat.

The term heat transfer efficiency is defined as:

$$\text{Heat Transfer Efficiency} = \frac{\text{Useful Heat Output}}{\text{Heat Generated by Combustion}}$$

The overall efficiency may therefore be defined as the combustion multiplied by heat transfer efficiency; thus:

$$\text{Overall Efficiency} = \frac{\text{Useful Heat Output}}{\text{Wood Energy Input}}$$

Burning Wood Efficiently

Burning wood is a simple matter . . . burning it efficiently is not. Even in some of the best stoves nearly 40 percent of the wood's heating value goes up the chimney.

There are many reasons for the difficulty in attaining higher efficiency in wood stoves, but one of the most important is the necessity of maintaining a controlled supply of air to the combustion zone.

The most important factor in controlling the supply of air to the firebed is the elimination or prevention of unwanted air leaks. Air leaks cause lower efficiency and performance because:

1. Some of the leaked air is not used in the burning process and passes up the flue taking heat with it.
2. Some of the leaked air is used in the burning process and reduces the effect of the inlet air-control setting.

3. Uncontrolled air inlets will make an overnight or slow, steady "burn" virtually impossible.

To assure good combustion, therefore, the stove should be of such quality that the only air permitted to enter it is that which is intended to enter through the air inlets.

This necessity for controlled combustion is what has led to the "air-tight" stove. Air-tight stoves can produce efficiencies that range as high as 70% or more. This is what enables wood stoves to burn steadily for 12 to 15 hours on a single charge of wood.

Distribution of the Heat

Getting the heat from stoves distributed to all parts of the house is not as difficult as it may first seem. Although wood stoves are local sources of heat, capable of maintaining a comfortable environment to almost any size room, it is usually desirable to distribute heat to other areas as well.

Stoves heat by radiation outward in all directions and by convection to the air immediately adjacent to the stove. At most normal operating conditions, stoves without fans or casings will transfer about twice as much heat by radiation than by convection (one-third of convection; two-thirds by radiation).

Radiation travels in straight lines until it strikes walls or room contents, where it is absorbed (heating the objects) or reflected.

The convection part of the heat output is a rising current of air which spreads out after reaching the ceiling. This heated air warms both the ceiling and the floor above it. The ceiling also becomes an effective radiant surface, warming objects below it.

The following ideas may be employed to greatly improve heat distribution:

1. Choose as central a location as possible. Stoves will be most efficient in delivering heat if located near the center of the areas to be heated.
2. Placement near stairs will greatly assist in heating areas above. Vertical distribution is natural since warmer air rises.
3. Heated air at the ceiling cannot easily pass under the tops of doorways and installation of a register at these locations will greatly aid lateral air movement.
4. Installation of registers through the ceiling will provide an upward current of warm air and help heat the areas above.
5. Use of the fan in the central heating furnace may be very useful in getting stove heat to all locations in the house, especially if the stove itself or a significant portion of its heat output is near the cold air return register.
6. Do not locate the stove in the basement unless you want to heat the basement! The largest component of radiant heat (two-thirds of the total) will be directed toward the walls and floor of the basement where it will do little or no good.

Accounting Scale

Wood can be burned in many different devices and under many different conditions. Because of this, the following accounting scale is given to indicate the various overall efficiencies (first column) and heat output from different systems.

THERMAL ACCOUNTING SCALE

	Heat Value Btu, per lb. Hardwood	Percent Moisture Content (Dry Wood)	Flue Gas Temperature	Combustion Efficiency	Comments
100%	8600	Zero (oven-dry)	Room Temp.	100%	This heat value, known as High Heat Value (HHV) is actually the stored SOLAR ENERGY in the wood
84%	7250	Zero (oven-dry)	400°F	100%	This heat value, known as Low Heat Value (LHV) accounts for the loss of available heat in the water vapor and flue gases at 400 F. Although the oven-dry wood had no water in it originally, water is produced during combustion. In Europe, efficiencies are usually based on the LHV. The LHV can vary, of course, with the flue gas temperature.
81%	7008	20(dry weight)	400°F	100%	This value represents the maximum available heat from seasoned wood (20% M.C.). It takes 1210 Btu to heat and vaporize water to 400 F. If the wood contains 20% of its dry weight in water then we would lose .2 x 1210 or 242 Btu's of otherwise available heat.
76%	6524	60 (dry weight)	400°F	100%	This value represents the maximum available heat from green or freshly cut wood, which averages about 60% moisture based on dry weight. This loss of an additional 484 Btu's from the same amount of seasoned wood represents a substantial (7%) reduction in net available energy. A seven percent return on a no risk investment is a good deal! Let the wood season.
65%	5590	20	400°F	100%	Maximum available heat from a high quality, well designed air-tight stove or furnance burning seasoned wood. This figure may be attained in actual practice but requires regular attention because these levels of efficiency are realized only over a relatively narrow range of firing rates.
50% to 60%	4300 to 5160	20	300-400°F	70%	This heat output may be realized over a relatively wide range of firing rates in a good quality air-tight stove with average operator skill.
38%	3250	20	300-400°F	Fairly low	Maximum available heat from a Franklin Stove with doors open. Somewhat less available energy with doors closed, due to the fact that the radiation from the fire to the room is blocked by the doors and more than offsets the loss of heated air up the flue. Same effect with glass door enclosure.
30%	2580	20	300-400°F	Fairly low	Heat expected from a typical well-designed Energy Saving Fireplace. These units are rapidly replacing the standard factory-built fireplaces designed in the 1950's. Burning only 14 lbs. of wood per hour, these units can produce heat outputs as high as 36,000 Btu enough to supply the heat requirements of a typical house on a cold day.
24%	2100	20	300-400°F	Low	Effect of a tubular grate with fan on the output of an open fireplace. This estimate is only that. We know of no careful testing of these devices by any manufacturer.
22%	1900	20	450-550°F	Moderate	Heat output of a tubular grate with a glass door with the doors CLOSED. See comment below regarding glass doors. There is expected to be some interference with the normal flow of radiant heat from an open fireplace equipped with these grates, but the actual net effect is not known.
15%	1290	20	300-400°F	Fairly low	Average efficiency of the typical open fireplace. It is important to realize that while the fire is burning, there is a considerable net heat gain which ranges from 10 to even 25 percent of the HHV. We use an average of 15% which is felt to be representative. The real loss from an open fireplace occurs after die-down and it is this one factor which has the most detrimental effect in fireplace overall performance.
10%	860	20	500-600°F	Moderate	This is the expected net output of a fireplace equipped with glass doors with the doors CLOSED. Closing the doors on an operating fireplace has the following effects: 1) radiation to the room is reduced by as much as 65%(2)much less heated air escapes up the chimney, and (3) because the combustion air is directed toward the base of the fire through the door grills, a hotter flame and higher stack temperature result. These effects are opposing from the standpoint of energy output. The real benefit from glass doors is that they prevent heat loss after the fire dies down - an equivalent effect at much less cost may be achieved with a stove board or tighly fitting non-combustible sheet placed over the face of the fireplace.

Information Sources

Mr. Robert D. Thulman, Thulman Eastern Corporation

Woodburners Encyclopedia. Jay Shelton and Andrew Shapiro, Vermont Crossroads Press, Waitsfield, Vermont. Dec. 1976

Prepared by Everette M. Prosise, Extension Housing Specialist

Published by

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Safe Wood Stove Installation Checklist

J.W. Bartok and E.L. Palmer,
University of Connecticut, Storrs

Wood stoves and heaters are being installed as a result of increased home heating costs. To protect your family and property, this equipment must be properly installed and operated. Use this checklist before starting the first fire in your stove to be sure it is safely installed.

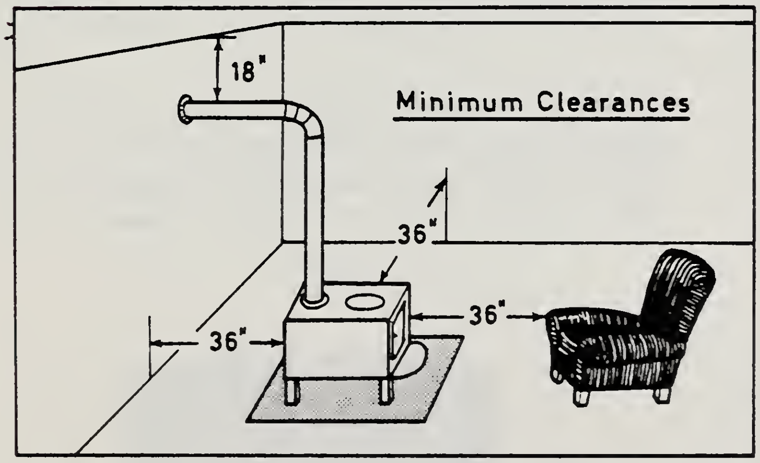
____1. The stove does not have broken parts or large cracks that make it unsafe to operate.

____2. A layer of sand or brick has been placed in the bottom of the firebox if suggested by the stove manufacturer.

____3. The stove is located on a non-combustible floor or an approved floor protection material is placed under the stove.

____4. Floor protection extends out 6 to 12 inches from the sides and back of the stove and 18 inches from the front where the wood is loaded.

____5. The stove is spaced at least 36 inches away from combustible material. If not, fire-resistant materials are used to protect woodwork and other combustible materials.



____6. Stove pipe of 22 or 24 gauge metal is used.

____7. The stove pipe diameter is not reduced between the stove and the chimney flue.

____8. A damper is installed in the stove pipe near the stove unless one is built into the stove.

____9. The total length of stove pipe is less than 10 feet.

____10. There is at least 18 inches between the top of the stove pipe and the ceiling or other combustible material.

____11. The stove pipe slopes upward toward the chimney and enters the chimney higher than the outlet of the stove firebox.

____12. The stove pipe enters the chimney horizontally through a fire clay thimble that is higher than the outlet of the stove firebox.

____13. The stove pipe does not extend into the chimney flue lining.

____14. The inside thimble diameter is the same size as the stove pipe for a snug fit.

____15. A double walled ventilated metal thimble is used where the stove pipe goes through an interior wall.

____16. The stove pipe does not pass through a floor, closet, concealed space or enter the chimney in the attic.

____17. A UL approved ALL FUEL metal chimney is used where a masonry chimney is not available or practical.

____18. The chimney is in good repair.

____19. The chimney flue lining is not blocked.

____20. The chimney flue lining and the stove pipe are clean.

____21. A metal container with tight fitting lid is available for ash disposal.

____22. The building official or fire inspector has approved the installation.

____23. The company insuring the building has been notified of the installation.

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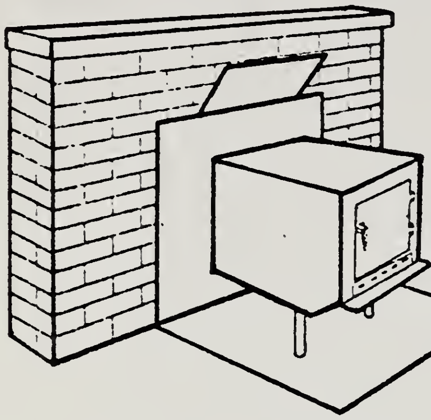
77-83

selecting fireplace wood

By Stanley Papanos, Extension Agent, retired

Connecticut Energy Extension Service

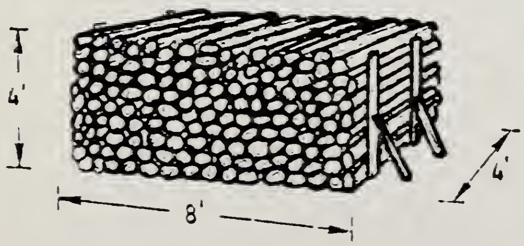


The United States Forest Service points out that choosing wood to burn in your fireplace is comparable to selecting wines or cheeses. Each species offers something different in aroma or heat value.

Soft woods, like pine, spruce, and fir burn rapidly with a hot flame. However, a fire built entirely of softwoods — just like a fire of paper — burns out quickly. For a longer fire combine softwoods with the heavier hardwoods such as ash, beech, birch, maple and oak. These hardwoods burn slowly and produce a steady supply of glowing coals.

Most wood will not burn if freshly cut. In fact, aspen, elm, sassafras, and swamp maple are almost impossible to burn if green. When buying fireplace wood be sure that it is reasonably dry or "seasoned."

Fireplace wood is usually sold by the cord. A cord is a well-stacked pile of wood, four feet wide, four feet high and eight feet long or 128 cubic feet. There is about 80 cubic feet of wood in a cord.



The rest is air space. When buying firewood, make sure you understand what unit you are buying. It may be sold by the truck load. Is it a stacked load or just randomly loaded? Is it a five yard body or a pick up truck? Ask before you buy! Also does the cost of the wood include stacking? It may be dumped in your driveway.

Finally, make sure the wood is cut in lengths to fit your stove or fireplace and that it is split.

The heating value of woods differ according to species. On a pound-for-pound basis, heavy hardwoods have about half the heating value of coal and a third of the heating value of oil.

The following table shows the heating value of woods commonly used in stoves and fireplaces:

Heating Value of Various Woods as Compared to Hickory

Kind of Wood	Heating Value
Hickory	100
Oak	86-99
Black Locust	95-98
Beech	89-91
Hard Maple	83-88
Birch	79-86
Apple	83-84
Ash	81-82
Elm	71-80
Soft Maple	67-83
Sycamore	70
Spruce	59
Hemlock	57
Aspen	53
Basswood	53
White Pine	50

COOPERATIVE EXTENSION SERVICE
COLLEGE OF AGRICULTURE AND NATURAL RESOURCES
THE UNIVERSITY OF CONNECTICUT, STORRS

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FACT SHEET

UNITED STATES
DEPARTMENT
OF AGRICULTURE

ENERGY
CONSERVATION
IN THE RURAL HOME

TIPS ON FINANCING HOME WEATHERIZATION

Would you like to add insulation, storm doors and windows, or make other home improvements to save money and energy but are short of cash? This information will help you.

If your house was cold and drafty last winter and your heating bills high, you should do something about it. First determine what you can do to save fuel. Make a list or ask a reliable contractor, your power supplier, or appropriate Government agencies for help.

You can pay for insulation and storm windows and doors with the money you save from smaller utility bills. Or you can finance home weatherization through banking institutions and Government agencies. You'll find two kinds of financial assistance generally available:

1. You can borrow money from some banks and lending agencies and pay on a monthly or other basis. Interest will be at current market rates or less.
2. If your income is below or near the poverty level, you may qualify for a grant.

The following brief description of sources for financing home weatherization will help you to determine which arrangements you may qualify for and where to get assistance.

Store Credit: Stores, lumberyards, and building supply firms may provide financing for weatherization materials they sell. If the material supplier also does the work, the total project may be financed by the store.

But the interest you pay the store on an annual basis may be higher than the interest you might pay on a refinanced mortgage, money you might borrow on your life insurance, or on some other straight interest loan. Truth in lending laws now require lendees to tell you what the interest rate on a loan is on an annual basis, so ask.

Shopping for Credit: Before you borrow money for your home weatherization project, get two or three estimates of cost from reliable contractors. Take these cost estimates with you when you go shopping for credit. It will pay you to shop carefully for the amount of money needed and the most favorable interest rate and payback period.

When looking for a loan always ask yourself these questions:

- What percent of the purchase price may I finance?
- What is the actual rate of interest I'll have to pay?
- What is the total amount of interest and special charges, if any, I will have to pay?
- How much extra interest will I have to pay if I pay off the loan sooner than scheduled?
- Will I have to provide collateral?
- According to the terms of the loan agreement, what will happen if I miss a payment?

Be sure you can live with the answers before you apply for the loan.

Farmers Home Administration (FmHA) programs serve people of rural areas and towns of up to 10,000 population. Under certain conditions loans can be made in places up to 20,000 population. Under a special program, weatherization loans under FmHA's Section 502 program are being made through participating public utilities. To qualify your home must be in a rural area as determined by the FmHA; you must have a low or moderate income and be unable to obtain credit from other sources; and your dwelling must meet minimum property standards when the weatherization work is completed.

Loans of up to $1,500 are made at 8 percent interest payable in up to 5 years. You apply for these loans at your public utility; loan payments are collected with monthly utility bills.

If your rural area is not served by a participating utility, or your weatherization needs exceed $1,500, or if you can't meet the terms of a loan through the utility, you can apply to the FmHA County Supervisor (listed

in phone book under U.S. Government, Department of Agriculture, FmHA) for assistance under another program.

FmHA's Section 504 program helps very low-income owner occupants make repairs to substandard houses to remove safety or health hazards. This includes weatherization. Loans at 1 percent interest rates are available, and grants are authorized for the elderly with income too low to repay a loan. The maximum assistance is $5,000.

FmHA loans are made to individuals to buy, build, or repair a home. Funds can be included in these loans for weatherization purposes. In fact, new homes financed by the FmHA must meet new weatherization standards, and existing homes must be weatherized to the extent practical.

If you need more information contact the local FmHA office.

The Department of Housing and Urban Development (HUD) assists with weatherization through a number of programs:

Title I offers Federal Housing Administration (FHA) insurance on home improvement loans. The maximum loan amount is $15,000 for a single-family home. The length of the loan is 15 years, with an interest ceiling of 12 percent. If you are interested, contact your local HUD office for information or apply for an insured loan through a lending institution in your community.

Section 312 offers direct Federal loans for rehabilitation at 3 percent interest with a repayment term of 20 years. The maximum amount of the loan is currently $27,000. Section 312 loans can be used for weatherizing a home. If the home has any code deficiencies, they must be repaired. To be eligible, homes must be in urban renewal areas, in code enforcement areas, or in areas designated for rehabilitation under the Community Development Block Grant Program.

Section 203(b) is the basic FHA program for mortgage insurance. You might consider refinancing your mortgage to cover weatherization costs, using Section 203(b) assistance. For additional information, contact your lending institution.

In the Community Development Block Grant (CDBG) Program, Federal grants are given to communities for development projects chosen by the communities themselves. Rehabilitation, including weatherization, of existing housing is eligible under this program. You might contact your mayor or the chief executive officer of your community to see if CDBG funds have been set aside for rehabiiltation in your area.

For additional information on any of the HUD programs, contact the nearest HUD office.

Department of Energy (DOE) has a weatherization program for low-income homeowners, especially for the elderly or handicapped. This voluntary grant-in-aid program is administered through your State energy office or State Economic Opportunity Office.

Eligible persons are those whose income is either at or below the poverty-level guidelines—$5,850 for a family of four—or those who received cash assistance payments under Aid to Families with Dependent Children or Supplemental Income during the past 12 months. Within these income tests, priority is given to serving the elderly and the handicapped. The ceiling on grants provided to each dwelling unit is $400 for materials (not labor) unless your State certifies that local conditions require a higher ceiling.

For more information about this program in your State, contact the Governor's office or write to Office of Weatherization Assistance, Department of Energy, Washington, D.C. 20461.

Department of Health, Education and Welfare (HEW), as part of Title XX of the Social Security Act, can provide funds to States for minor home repairs or renovation, which includes weatherization work. Funds are available for this program in most States.

You may be eligible for a grant if you have an income up to 115 percent of the State's median income as adjusted for family size. For further information on home repair grants, contact your local welfare department.

Administration on Aging (AOA) serves the elderly, 60 years and over, with a range of social services under Title III of the Older Americans Act. Among these services is assistance to eligible households with installation of storm doors and windows and insulation, caulking, and weatherstripping.

For more information, contact your State Office on Aging.

TVA Home Insulation Program: The TVA home insulation program, offering interest-free insulation loans and free home energy surveys, potentially can assist every consumer in the TVA Region. Loans must be repaid in at least 3 years as an additional charge on each monthly electrical bill.

If you're interested, request a free home energy survey from your local power distributor. These surveys are available regardless of how you heat your home. Special energy advisors are being hired and trained by power distributors to work in the field with the local systems in making the surveys.

If the energy advisor finds that you, as an electric heating or cooling consumer, have less than R-19 value attic insulation, you will be offered an interest-free loan to get the insulation installed. You make your own arrangements with local contractors to have the work done. When the job passes inspection, the local power distributor pays the contractor for his services.

If you can do the insulation job yourself, you may receive a loan for the cost of materials only.

If you don't heat or cool electrically you will get the same thorough inspection of your home as those who do, and the energy advisors will recommend measures that you can take to save energy and fuel costs.

Community Services Administration (CSA): Among other things CSA promotes energy conservation and works to lessen the impact of high energy cost on low-income individuals and families. It develops community-based programs to deal with energy-related problems and mobilizes resources within the State and community to help the poor deal with the energy crisis. A major part of the program supports weatherization activities which will increase the thermal efficiency of the homes of eligible participants who are the poor and near-poor in both rural and urban areas.

For this program, the near-poor are defined as those persons whose incomes are between 100 percent and 125 percent of the poverty thresholds.

CSA's energy programs are coordinated by their Office of Community Action. For more information, contact your Community Action Agency, State Economic Opportunity Office, or the Community Service Administration, 1200 19th Street, N.W., Washington, D.C. 20506.

Banks, Savings and Loans, Credit Unions, and other Credit Agencies will provide credit for insulation and other weatherization improvements for families who can qualify for conventional loans. In some areas, banks and other lending agencies are making special low interest loans for energy conservation measures to homeowners.

Power Suppliers: Many public and private utilities are providing credit to their customers for home insulation and other weatherization improvements.

Contact your power supplier for further information.

Fact Sheets In The Home Weatherization Series

1. Why Weatherize Your Home?
2. How To Determine Your Insulation Needs
3. Save Heating And Cooling Dollars With Weatherstripping And Caulking
4. How To Save Money With Storm Doors And Windows
5. What To Look For In Selecting Insulation
6. How To Install Insulation For Ceilings
7. How To Install Insulation For Walls
8. How To Install Insulation For The Floor And Basement
9. Solving Moisture Problems With Vapor Barriers And Ventilation
10. Weatherize Your Mobile Home To Keep Costs Down, Comfort Up
11. Tips On Financing Home Weatherization
12. Keeping Home Heating And Cooling Equipment In Top Shape
13. Landscaping To Cut Fuel Costs
14. Home Management Tips To Cut Heating Costs
15. Locating New Home Sites To Save Fuel

Single copies are available upon request to Special Reports Division, Office of Governmental and Public Affairs, U.S. Department of Agriculture, Washington, D.C. 20250.

This series of fact sheets was assembled from research, Extension, and other sources by the USDA Task Force on Weatherization.

Agricultural Fact Sheet 2 - 3 - 3

United States Department of Agriculture
Office of Governmental and Public Affairs
Washington, D.C. 20250

April 1978

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FEDERAL FUNDING FOR YOUR CONSERVATION PROJECT

Where the money is and how you can get some of it for your utility

By KAREN ANDERSON, *energy conservation representative, American Public Power Association; contributing editor,* PUBLIC POWER

Securing Federal assistance for your local public power system's energy conservation project may seem like a lot of work for little reward. But the Federal government does have a number of energy funding programs which, once located, can be tapped by publicly owned electric power systems for their conservation projects.

The first stop on your Federal fund-raising effort should be a 1,000-page, loose-leaf document entitled "Catalog of Federal Domestic Assistance." Available at many libraries or from local government offices, the catalog lists various funding programs, including information on eligibility, application procedures, and established deadlines. The catalog can be purchased on a yearly subscription basis from the Government Printing Office, Washington, D.C. 20545 ($18 annually).

What the catalog fails to tell is which of the Federal funding programs are truly open — that is, which are not carry-over or foreclosed programs. For this information, it is best to contact the agency directly.

The following is a description of the principal Federal government energy conservation funding programs.

DEPARTMENT OF ENERGY, *Washington, D.C. 20545; 202/566-6061.*

Within the Department of Energy (DOE), there are several energy conservation project areas of interest to local publicly owned electric utilities.

The Office of Utility Programs in DOE's Economic Regulatory Administration has $8-million this fiscal year and $10-million in fiscal 1979 to fund innovative conservation and rate-setting projects. Several local public power systems already are receiving funds under this program, including: Department of Lighting, Seattle, Wash.; Department of Water and Power, Los Angeles, Calif.; Grand River Dam Authority, Vinita, Okla.; and City Utilities, Springfield, Mo. Several new projects will be funded this year.

The DOE Conservation and Solar Applications Division administers with the Community Services Administration a three-year, $530-million weatherization program to assist low-income people in weatherizing their homes. Grants are made to the state, which in turn allocate the funds to local governments. If a state fails to apply for funding, grants may be made directly to local governments. Budget authority for this program is $64-million in fiscal 1978 and jumps to $199-million in fiscal 1979. For further information, contact: Mary Bell, director, Weatherization Assistance Program (202/566-3091).

A DOE demonstration program for solar heating and cooling of commercial buildings consists of a series of five "cycles" of projects repeated at intervals of nine months to a year. The next cycle will be the fourth, with notices going out this fall and about $10-million available in grants. Contracts are awarded on a competitive basis according to the technical merit of the program and the "uniqueness" of the project in terms of geographic location, building type, institutional factors, type of solar system, etc. Contact is Bill Corcoran (202/376-9604).

The DOE Conservation and Solar Applications Division also solicits proposals in the following areas: heating and cooling of buildings; industrial and agricultural heating; photothermal and photovoltaic electric generation, wind energy systems, ocean thermal systems, small hydroelectric projects and biomass conversions. Requests for proposals (RFPs) are listed in the "Commerce Business Daily" (Government Printing Office, Washington, D.C. 20545, $75 per year), or one may contact directly the program manager in each of the various areas.

Some of the contact people in the Conservation and Solar Applications Division: high temperature thermal conversion, Gerald Braun (202/376-1933); utility/total energy systems, Jim Rannels (202/376-4819); solar heating and cooling, Rhett Turnipseed (202/376-9610); ocean thermal, Jim Madewell (202/376-4761); wind energy systems, Louis V. Divone (202/376-4878); photovoltaics, Paul Maycock (202/376-1957); and biomass, Roscoe Ward (202/376-1610).

Areas of conservation interest within DOE's Energy Technology Division include: high efficiency electric power transmission and distribution systems; alternative transportation systems, including electric vehicles; energy storage techniques; advanced conversion systems such as fuel cells, Stirling engine, etc., as well as technologies such as geothermal, low-head hydro and advanced solar. RFPs are announced in "Commerce Business Daily" and can be obtained from program managers.

Unsolicited proposals are accepted by some DOE branches. Applications may come in at any time, and there is usually a delay of three to six months in getting a decision. To determine which office would be likely to fund a specific proposal, contact DOE's Office of Industrial, State and Local Relations (202/376-4934).

DOE's regional offices all have discretionary funds which have been used to support energy planning studies of various sorts.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, *451 Seventh St., SW, Washington, D.C. 20410; 202/755-6422.*

The Department of Housing and Urban Development (HUD) is becoming active in energy funding through administration of its residential solar demonstration program, development of national thermal efficiency standards and other community programs.

HUD administers a residential solar heating and cooling demonstration program similar to DOE's program for commercial buildings. Program manager is David Moore of the Office of Policy Development and Research (202/755-6970).

The Comprehensive Planning Assistance Program — the "701" program — provides funds for planning activities carried out by state, local and regional governments. The program supports local energy planning, such as revision of building codes, mass transit planning, energy audits of buildings, development of weatherization programs, etc.

HUD identifies five categories of recipients eligible for "701" funds: states, for statewide planning; states, for local assistance to non-metropolitan cities and urban counties; cities over 50,000 population; urban counties of over 200,000 population; and regional metropolitan and non-metropolitan organizations. Applications are made to and grants awarded by HUD regional offices. Money is awarded on an 80-20 matching basis, and appropriations for the current fiscal year are $57-million. Local public power systems should contact their state energy offices for more information. At the national level, contact Jerry Friedman (202/755-6226).

HUD's Community Development Block Grant program is a $3-billion-plus program that provides money for a variety of community improvement projects. Fostering energy conservation was not one of the original goals of the program, but guidelines were written loosely and funds may be used for retrofitting insulation and other conservation improvements in public buildings and, possibly, public housing. Applications must be filed with HUD area offices. Allocation of the funds is complicated, but

generally 20% is reserved for non-metropolitan areas.

The Innovative Projects Program is a smaller ($15-million) spinoff program to encourage locally developed solutions to community problems. This program accepts unsolicited proposals and has funded several small demonstration projects for energy conservation, including a 1975 grant to the City of Anaheim, Calif., for municipal energy planning. Criteria for the program vary each year; this year, the themes were urban reinvestment and deconcentrated housing for low-income families. Several applicants included energy conservation activities as part of their overall proposals, e.g., redeveloping an urban area and upgrading insulation of the older homes. Guidelines for next year's program will be published in the "Federal Register" this fall, and applications will be due about four months thereafter. Inquiries can be directed to Bill Sanborn in the HUD Office of Community Development and Planning (202/755-5620).

Modular Integrated Utility Systems is a demonstration program for on-site total energy systems. One project in New Jersey converts solid waste into fuel, burns the fuel for electricity and recovers the waste heat from electric generation for space and hot water heating. Information on this program may be obtained from the HUD Information Center, 451 Seventh St., SW, Washington, D.C. 20410; 202/755-6422.

ECONOMIC DEVELOPMENT ADMINISTRATION, *Department of Commerce, 14th and E Sts., NW, Washington, D.C. 20230; 202/377-5113.*

Economic Development Administration (EDA) has grants and loans available for public works. EDA's Office of Technical Assistance supplies grants-in-aid (with a 25% match by the applicant) or contracts with state and local governments. Last fall, more than $7-million was approved by EDA for energy-related projects in 18 states and Puerto Rico. Among the awards were $430,000 to the City of Fort Collins, Colo., for solar heating and remodeling of the City Hall and $1,264,127 to the City of Klamath Falls, Ore., for roads and utilities for a geothermal industrial park.

The Commerce Department budget contains no funds for further energy-related grants by EDA, but a similar program may be developed under President Carter's urban program.

EDA also offers a professional services program which provides energy analysts to assist local governments in developing energy conservation programs and the use of alternative energy sources. Contact at EDA is Bernard Richert (202/377-5103).

COMMUNITY SERVICES ADMINISTRATION, *1200 19th St., NW, Washington, D.C. 20036; 202/254-5840.*

Community Services Administration (CSA), which operates through 800 Community Action Agencies across the country, has an Emergency Energy Conservation Program funded at $65-million this year and administered by the local action agencies. Programs are aimed at alleviating the effect of high energy costs on the poor. Typical projects involve weatherization, emergency energy payments, consumer information, education and legal assistance, transportation, and alternative energy systems that can be adapted to supply the energy needs of low-income families.

To identify your closest community action agency, call the CSA Agency Information Locator at 202/254-6110. A pamphlet, "Applying for a CAP Grant," is available from CSA's Public Affairs Office. (This program is scheduled to be transferred to the Department of Energy next year.)

Columbia, Mo., finances home insulation projects, above, with Federal funds from several programs. The city uses money from a Housing and Urban Development community development block grant as seed money for a 25% local-75% Federal Title 20 grant from the Department of Health, Education and Welfare. The city then turns the money over to local insulation contractors who, in turn, use CETA funds from the Department of Labor to weatherize homes. Sixty home projects have been financed this way, and another 180 homes are on the waiting list.

NATIONAL CENTER FOR APPROPRIATE TECHNOLOGY, *P.O. Box 3838, Butte, Mont. 59701.*

The National Center for Appropriate Technology (NCAT) is an independent organization funded for $3-million in fiscal year 1977 by the Community Services Administration. The purpose is to encourage conservation and alternative resource development as a means of solving the energy problems of low-income persons. NCAT is interested in funding not only the technologies but also community-based utilization programs, networking and community outreach.

Grants have been made for this year, and program notices for next year will be out in June. Grant applications have open-ended deadlines, and the Center also accepts unsolicited proposals. For more information, contact Margie Ledward (406/723-5474).

EMPLOYMENT AND TRAINING ADMINISTRATION, *Department of Labor, 200 Constitution Ave., NW, Washington, D.C. 20212; 202/376-6366.*

The Comprehensive Employment and Training Act (CETA) provides funding for projects ranging from local job training to upgrading public service employment. Several local public power systems use CETA money to help finance the labor involved in weatherization programs. In one Rhode Island community, CETA funds support a training program that teaches people to build and install solar hot water heaters.

CETA funds are apportioned out on a "formula grant" basis to about 460 states, counties and large cities (over 100,000 population). Smaller communities can tie into these programs by working with the local grantee, whose name can be obtained from the appropriate state labor office (office of human resources or office of employment security). Information about the program also can be found at regional Department of Labor offices.

FARMERS HOME ADMINISTRATION, *Department of Agriculture, Independence and 12th St., SW, Washington, D.C. 20250; 202/447-4343.*

The Farmers Home Administration (FmHA) program of low-interest weatherization loans has been expanded to include rural customers of local publicly owned and investor owned electric utilities. Information is

available from the 1,700 FmHA offices, usually located in county seats. Location of the nearest FmHA office may be obtained by writing to FmHA.

ENVIRONMENTAL PROTECTION AGENCY, *401 M St., SW, Washington, D.C. 20460; 202/755-0707.*

Environmental Protection Agency (EPA) offers technical information and counseling to assist municipalities in solving local solid waste problems. Grants to train personnel in managing, operating or designing solid waste facilities are available in limited amounts. Inquiries should be addressed to the EPA Grants Administration Division.

Money on a matching basis for devising solid waste management plans is available as planning grants to state agencies by the regional EPA offices or directly from the EPA Office of Solid Waste Management. This program is funded at more than $1-million.

Special grants for solid waste demonstration will be announced in the "Commerce Business Daily" and will be awarded by the Office of Solid Waste Management. Demonstration grants will fund up to 75% of the total project cost, and several have been awarded to local communities.

EPA's Municipal Environmental Research Laboratory in Cincinnati, Ohio, administers a "Waste as Fuel" grants program, which is announced through RFPs in "Commerce Business Daily."

Under the Resource Conservation and Recovery Act of 1976, $30-million is allocated in the current fiscal year to state and local organizations for solid waste, resource recovery and recycling programs. EPA also will provide teams to offer technical assistance without charge in these areas. EPA is still in the process of developing this program, and inquiries should be addressed to the EPA Office of Solid Waste Management.

Pat Griffis, right, supervisor of media for Grand River Dam Authority, Vinita, Okla., shows aerial thermograms to municipal utility officials from Sallisaw, Okla. The thermogram program is part of a $500,000 energy conservation project of GRDA which has received 50% funding from the Department of Energy. Other features of the GRDA project include time-of-day metering, elimination of declining block rates and condition of service contracts establishing insulation requirements.

Once you've matched your project to an appropriate program, you will need to make the application for funds. For assistance in composing the grant application, try "Program Planning and Proposal Writing," a booklet published by the Grantsmanship Center, 1015 W. Olympic Blvd., Los Angeles, Calif. 90015 (75 cents). The Center also publishes a "Basic Grantsmanship Library" (75 cents) which lists several useful publications on the subject.

If you're successful in obtaining Federal funding from any of these programs, you'll need advice on managing your Federal grant. Two dull-sounding publications from the Office of Management and Budget and the General Services Administration are indispensable in the field of Federal grant management.

"OMB Circular A-102" sets out administrative standards for grants-in-aid to state and local governments. It identifies what may be used for matching shares, imposes standards for financial reporting and management, and explains budget revision procedures. Free from: OMB, Executive Office Bldg., 17th and Pennsylvania Ave., NW, Washington, D.C. 20006.

"Federal Management Circular 74-4" establishes principles for determining allowable costs for grant programs from the point of view of the agency administering grants to local and state governments. Free from: General Services Administration, Washington, D.C. 20405.

A major source of Federal energy conservation money these days is your state energy office. From the Department of Energy alone, states are receiving funds for conservation under three different programs: State Plans (authorized by the Energy Policy and Conservation Act of 1975); State Supplemental Plans (Energy Conservation and Production Act of 1976); and the Energy Extension Service.

The program of the Energy Extension Service is in a 10-state pilot stage and due to be extended to all 50 states next year. In several of the pilot states, local public power systems are participating in the programs. Utilities should contact their state energy offices and work with them in developing mutually agreeable conservation programs. The pilot states are funded by $1.1-million grants each from DOE, and other states each have $30,000 in planning money.

In addition to the Federal government, more than 26,000 private foundations have grant programs, some of which might help support energy conservation projects.

The Foundation Center (888 Seventh Ave., New York, N.Y. 10019; 212/489-8610) can provide reference facilities and assistance in seeking foundation grants. The Center publishes a number of helpful, free publications, including: "What Makes a Good Proposal"; "What Will a Foundation Look For When You Submit a Grant Proposal"; and "Philanthropy in the United States: History and Structure."

With the growing interest in energy conservation, there are funds available to assist soundly-conceived, promising and innovative projects. Good luck! ☐

August 1978

FACT SHEET

SCHOOLS, HOSPITALS, LOCAL GOVERNMENT AND PUBLIC CARE BUILDINGS GRANTS PROGRAM

Background

Realizing the pressure that rising energy costs are placing on the Nation's schools and hospitals, President Carter included in the National Energy Act a major grants program to help those institutions make energy conserving improvements to their buildings. Following presentation of the President's program on April 20, 1977, both Houses of Congress dealt with the program independently, passing separate bills in July and August. In both versions, the program will provide $900 million in 50 percent matching grants over three years to schools and hospitals to make their buildings more energy efficient. The House of Representatives added a separate section providing an additional $65 million to assist local government and public care buildings as well. Though the major thrust of the House and Senate bills is the same, there are differences that must be resolved by joint conference committee. The committee began its work on October 20, 1977. Although the final version of the legislation is not yet available, the committee is basically adopting the provisions of the House bill, H.R. 8444.

Program Operation

H.R. 8444 provides funding for preliminary building energy audits, technical assistance (detailed building energy audits), and energy conservation projects (actual implementation of capital improvements).

The authorized funding levels for schools and hospitals are as follows:

	Preliminary Energy Audits	Technical Assistance	Total Energy Conservation Projects and Technical Assistance
FY 78	$20 million	Up to 30% of ECP (or $54 million)	$180 million
FY 79	$5 million	Up to 15% of ECP (or $44-1/4 million)	$295 million
FY 80	--	Up to 5% of ECP (or $20 million)	$400 million
TOTAL	$25 million		$875 million

Local Government and Public Care Buildings are under a separate authorization. $65 million over 2 years to local government and public care buildings for preliminary energy audits and technical assistance (no projects).

$15 million for preliminary energy audits

$50 million for technical assistance

The program is divided into two phases. Under the initial phase, the Department of Energy (DOE) will make grants to each State to conduct a State-wide program of preliminary energy audits in all appropriate buildings. These preliminary energy audits will establish a "building profile" of each eligible facility (with respect to type, size, energy use level and energy using systems), identify changes in operations and maintenance procedures which would reduce energy consumption without significant capital expenditure, and analyze the payback periods of various possible building retrofit measures. Through implementing the operations and maintenance recommendations resulting from a preliminary energy audit, we estimate that most schools and hospitals will be able to reduce their energy consumption at least 10-15%.

In Phase II of the program, DOE will make grants to schools and hospitals for technical assistance programs and energy conservation projects. To be eligible for a technical assistance program grant:

(1) the facility must have had an acceptable preliminary energy audit, either under Phase I of this program or independently;

(2) the operations and maintenance procedures recommended as a result of that audit must have been implemented, and

(3) results of that audit must also indicate that further retrofit measures, involving significant expense, would pay back in 10 years or less.

To be eligible for an energy conservation project grant, the building must have had a detailed energy analysis which indicates that the building modifications proposed will pay back in 10 years or less.

Grants under the second phase of the program will be awarded to eligible institutions in accordance with State-wide plans developed by each State Energy Office and approved by DOE. Grant applications will be submitted annually to DOE through the State Energy Offices, who will approve and prioritize them for funding and then forward the applications to DOE for final approval and grant award.

Schools and hospitals will be able to use in-kind contributions (such as salaries of personnel and building materials on hand, etc.) to make up all or part of their 50% matching funds. New construction is not included in this grant program.

In order to make the funds under this program available as soon as possible, DOE is drafting the proposed regulations governing each phase of the grants program. Within 90 days of passage of the final legislation, these proposed regulations will be issued for comment and final regulations will be published.

-- Under the proposed law, Schools would receive a minimum of 30% of the Federal share and Hospitals also would receive at least 30% of the Federal monies. The remaining 40% would be available based upon recommendations of each State energy office.

-- No state may receive more than 10% of funds or less than 0.5%.

-- All funds granted to State or individual facility must be matched 50/50 from non-federal funds.

Additional information may be obtained by writing:

Michael Willingham
Acting Director
State Specific Programs, CS
U.S. Department of Energy
NPO-6454, Stop 461
Washington, D.C. 20461

NATIONAL ENERGY CONSERVATION POLICY ACT OF 1978

The purposes of the National Energy Conservation Act of 1978 are to provide for the regulation of interstate commerce, to reduce the growth in demand for energy in the United States, and to conserve nonrenewable energy resources produced in this Nation and elsewhere without inhibiting beneficial economic growth.

Utility Programs - Residential Energy Conservation

Conservation Measures

Under the Act, the Secretary of Energy will establish, by rulemaking, suggested residential energy conservation measures and related standards for safety, effectiveness, installation, prices, interest rates, unfair competition, etc. Residential Energy Conservation Measures include (1) caulking and weatherstripping; (2) furnace efficiency modifications; (3) clock thermostats; (4) ceiling, attic, wall, and floor insulation; (5) water heater insulation; (6) storm windows and doors, (7) devices associated with load management techniques; and (8) devices to utilize solar energy or windpower. The Secretary of Energy will identify the suggested measures for residential buildings by climatic region and on the basis of the type of construction.

State Plans

The Act provides for the establishment of residential energy conservation plans by each state and by covered nonregulated utilities. These plans must meet certain requirements and will mandate the implemention of approved energy conservation programs by covered utilities.

Coverage

In the case of electric utilities those covered include all those with retail sales exceeding 750 million kWh. Nothing in the Act, however, seems to prohibit a state from establishing a program that is more inclusive; that is, a state could cover smaller utilities, with rules similar to the Federal provisions, under State law. In addition, a state may include in its plan nonregulated covered utilities.

Utility Programs

The nonregulated utility or State plans will outline requirements for the utility programs. The utilities must provide consumers with certain information and services. The information provided must include (1) the suggested residential energy conservation measures; (2) likely savings in energy costs that would result from installation of the suggested measures; (3) availability of arrangements for installation and financing through a list of suppliers and lending organizations; and (4) suggestions for conservation techniques.

With regard to the minimum services, each covered utility must also offer (1) to inspect residential buildings; (2) arrange to have the suggested residential energy conservation measures installed; and (3) arrange for financing. Repayments of any loans for the purchase and installation of the conservation measures must be permitted as part of the utility bill. No termination of service is allowed for nonpayment of this portion of the utility bill.

Generally, the covered utilities are prohibited from supplying, installing, or financing the residential energy conservation measures. However, there are several exceptions. A utility may supply, install, or finance furnace efficiency modifications, clock thermostats, and related load management devices; make loans of up to $300 or the cost to purchase and install the above furnace related items (whichever is greater); and may continue certain programs in effect when the bill is enacted or where a substantial amount of preparation or advertising has been made.

A utility is also prohibited, except where requested in writing, from inspecting a furnace or suggesting any furnace modification if the utility does not supply the primary source of fuel or energy for that furnace.

There are also provisions to require compliance, give DOE standby authority in case of noncompliance, insure fairness in drawing up the required lists of suppliers and lending institutions, and to insure fairness in carrying out the procedures.

There are complex procedural and time requirements. It appears that the rulemaking steps could be completed by about mid-1979. Approvals of the State plans or the nonregulated utility plans might then be expected late in the year with the programs going into effect early in 1980.

Other Provisions

The above requirements of the National Energy Conservation Policy Act have the potential for the most immediate and direct impact on REA borrowers. Other aspects of the Act, however, will have significant long-run effects by reducing the growth in demand for energy. The following outlines some of the other provisions of this Act:

1. Weatherization grants for the benefit of low income families through the Department of Energy and the Farmers Home Administration.

2. Secondary financing and loan insurance for energy conserving improvements and solar energy systems.

3. Energy conserving improvements for assisted housing.

4. Energy conserving standards for newly constructed residential housing insured by Federal Housing Administration or assisted by Farmers Home Administration.

5. Energy conservation programs for schools, hospitals, and buildings owned by units of local governments and public care institutions.

6. Energy efficiency standards for automobiles.

7. Energy efficiency standards for appliances.

8. Demonstration of solar heating and cooling in Federal buildings.

9. Energy conservation and solar energy in Federal buildings.

10. Industrial energy efficiency reports.

11. State energy conservation plans.

STATE & CODE	STATE DIRECTOR, OFFICE LOCATION, MAILING ADDRESS & TELEPHONE(*)	STATE DIRECTOR'S HOME ADDRESS (**)
Alabama (01)	Elizabeth Wright Room 717 Aronov Building 474 South Court Street Montgomery, Ala. 36104 P. O. Box 1165 Montgomery, Ala. 36102 Commercial: 205-832-7077 FTS: 534-7077 (***) CDT: 8:00 a.m. to 4:45 p.m.	4206 Camellia South Montgomery, Alabama 36109 Tel: 205-272-1664
Alaska (60)	John R. Roderick P. O. Box 1289 Palmer, Alaska 99645 Commercial: 907-745-2176 (NOTE: Dial 8-399-0150 Give Seattle FTS Operator Commercial Number 907-745-2176) (***) A-HST 8:00 a.m. to 4:30 p.m.	1620 Hidden Lane Anchorage, Alaska 99501 Tel: 907-272-8089
Arizona (02)	Manuel O. Dominguez Room 3433 Federal Building 230 North First Avenue Phoenix, Arizona 85025 Commercial: 602-261-6701 FTS: 261-6701 (**) MST: 7:30 a.m. to 4:00 p.m.	8334 North 58th Avenue Glendale, Arizona 85302 Tel: 602-937-7797
Arkansas (03)	Sherman Williams 5529 Federal Office Building 700 West Capitol Little Rock, Arkansas 72201 P. O. Box 2778 Little Rock, Arkansas 72203 Commercial: 501-378-6281 FTS: 740-6281 (***) CST: 8:00 a.m. to 4:30 p.m.	2000 Rebsemn Park Road Apt. 104-F Little Rock, Arkansas 72207 Tel: 501-663-1014
California (04)	Lowell A. Pannell 459 Cleveland Street Woodland, California 95695 Commercial: 916-666-2650 FTS: 448-3223 (***) PST: 7:30 a.m. to 4:00 p.m.	1035 Kristen Court San Jose, California 95120 Tel: 408-268-7427 Temporary Residence: 2806 Bidwell Street, Unit 3 Davis, California 95616 Tel: 916-758-9375

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Colorado (05)	Ernest C. Phillips Room 231, #1 Diamond Plaza 2490 West 26th Avenue Denver, Colorado 80211 Commercial: 303-837-4347 FTS: 327-4347 (***) MST: 8:00 a.m. to 4:30 p.m.	3012 South Fenton Denver, Colorado 80227 Tel: 303-986-6316
Delaware (07) District of Columbia Maryland (24)	John D. Daniello Robscott Building 151 East Chestnut Hill Road, Suite 2 Newark, Delaware 19713 FTS: 487-6694 Commercial: 302-573-6694 (***) EST: 8:00 a.m. to 4:30 p.m.	2326 Jamaica Drive Wilmington, DE 19810 Tel: 302-475-5518
Florida (09)	Michael R. Hightower Room 214, Federal Building 401 S.E. 1st Avenue Gainesville, Florida 32602 P. O. Box 1088 Gainesville, Florida 32602 Commercial: 904-376-3210, 3218, 3219 FTS: 946-7221, 7222, 7229 (***) EDT: 8:00 a.m. to 5:00 p.m.	2830 St. Johns Avenue Jacksonville, Florida 32203 Tel: 904-387-3712 P.O. Box 128 Gainesville, Fla. 32602
Georgia (10-11)	Robert L. Blalock 355 E. Hancock Avenue Stephens Federal Building Athens, Georgia 30601 Commercial: 404-546-2162, 2163 FTS: 250-2162, 2163 (***) EDT 8:00 a.m. to 4:30 p.m.	P.O. Box 169 Athens, Georgia 30601 Tel: 404-353-2144
Hawaii (61)	Megumi Kon 345 Kekuanaoa Street Hilo, Hawaii 96720 Commercial: 808-961-4781 (***) A-HST: 7:30 a.m. to 4:00 p.m.	22 Kapaa Street Hilo, Hawaii 96720 Tel: 808-935-4364

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Idaho (12)	Joe T. McCarter Room 429, Federal Building 304 N. Eighth Street Boise, Idaho 83702 Commercial: 208-384-1730 FTS: 554-1318 (***) MST: 8:00 a.m. to 4:30 p.m.	2551 East Boise Avenue Boise, Idaho 83706 Tel: 208-336-7518
Illinois (13-14)	Jon W. Linfield 2106 W. Springfield Ave. Champaign, Illinois 61820 Commercial: 217-356-1891 FTS: 958-9155, 9149 (***) CST: 8:00 a.m. to 5:00 p.m.	307 W. Clark Apt. 302 Champaign, Illinois 61820
Indiana (15)	James E. Posey Suite 1700 5610 Crawfordsville Road Indianapolis, Indiana 46224 Commercial: 317-269-6415 FTS: 331-6415 (***) EST: 7:45 a.m. to 4:30 p.m.	3709 Rockwood Street Fort Wayne, Indiana 46815 Tel: 219-484-2342 Temporary Residence: Classic Motor Lodge 16th Street Speedway, Indiana 4622[illegible] Tel: 317-248-9271
Iowa (16)	Max L. McCord Room 873, Federal Building 210 Walnut Des Moines, Iowa 50309 Commercial: 515-284-4663 FTS: 862-4663 (***) CST: 8:00 a.m. to 4:30 p.m.	1004 North C Street Indianola, Iowa 50125 Tel: 515-961-2161
Kansas (18-19)	John T. Denyer 444 SE Quincy Street Topeka, Kansas 66683 Commercial: 913-295-2870 FTS: 752-2870 (***) CST: 8:00 a.m. to 4:30 p.m.	1320 West 27th, Apt. K-85 Topeka, Kansas 66611 Tel: 913-232-2309

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Kentucky (20-21)	William E. Burnette 333 Waller Avenue Lexington, Kentucky 40504 Commercial: 606-233-2733 FTS: 355-2733 (***) EST: 8:00 a.m. to 4:45 p.m.	1007 Tierra Linda Street Frankfort, Kentucky Tel: 502-695-2334
Louisiana (22)	Nimrod T. Andrews 3727 Government Street Alexandria, Louisiana 71301 Commercial: 318-448-3421 FTS: 497-6611 (***) CST: 8:00 a.m. to 5:00 p.m.	Route 1, Box 189 D Trout, Louisiana 71371 Tel: 318-992-4872
Maine (23)	Seth H. Bradstreet USDA Office Building Orono, Maine 04473 Commercial: 207-866-4929 FTS: 833-7445, 7446, 7386 (***) EST: 8:00 a.m. to 4:30 p.m.	Post Office Box 207 Newport, Maine 04953 Tel: 207-368-4440
Massachusetts (25) Connecticut (06) Rhode Island (45)	William E. Curry 358 North Pleasant Street Amherst, Massachusetts 01002 Commercial: 413-549-2820 (***) EST: 8:00 a.m. to 4:30 p.m.	Town Farm Road Farmington, CT 06032 Tel: 203-677-2214
Michigan (26)	Robert L. Mitchell Room 209 1405 South Harrison Road East Lansing, Michigan 48823 Commercial: 517-372-1910 plus Ext. 272 FTS: 374-4272 (***) EST: 8:00 a.m. to 4:30 p.m.	6061 East Lake Drive Haslett, MI 48840 Tel: 517-339-1007
Minnesota (27)	John F. Apitz 252 Federal Office Building & U.S. Courthouse St. Paul, Minnesota 55101 Commercial: 612-725-5842 FTS: 725-5842 (***) CST: 8:00 a.m. to 4:30 p.m.	817 Snelling Avenue, North St. Paul, Minnesota 55104 Tel: 612-644-5989

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Mississippi (28)	Mark G. Hazard Room 830 Milner Building Jackson, Mississippi 39201 Commercial: 601-969-4316 FTS: 490-4316 (***) CST: 8:00 a.m. to 4:30 p.m.	220 Edgewood Terrace A-021 Jackson, Mississippi 39206 Tel: 601-981-8363
Missouri (29-30)	Allan H. Brock 555 Vandiver Drive Columbia, Missouri 65201 Commercial: 314-442-2271 plus Ext 3241 FTS: 276-3241 (***) CST: 8:00 a.m. to 4:30 p.m.	2307 Fairmont Columbia, Missouri 65201 Tel: 314-445-4757
Montana (31)	Wallace B. Edland Federal Building P.O. Box 850 Bozeman, Montana 59715 Commercial: 406-587-5271 Ext. 4211 FTS: 585-4211 (***) MST: 8:00 a.m.to 5:00 p.m.	Alpine Way, Route 2 Box 28C Bozeman, Montana 59715 Tel: 406-587-9157
Nebraska (32)	Leonard T. Hanks Room 308 Federal Building 100 Centennial Mall North Lincoln, Nebraska 68508 Commercial: 402-471-5551 FTS: 867-5551 (***) CST: 8:00 a.m. to 4:30 p.m.	6228 Oak Hills Plaza Omaha, Nebraska 68137 Tel: 402-895-6578
New Jersey (35)	Lawrence E. Suydam 1 Vahlsing Center Robbinsville, NJ 08691 Commercial: 609-989-2376 FTS: 483-2376 (***) EST: 8:00 a.m. to 4:30 p.m.	28 State Park Drive Titusville, NJ 08560 Tel: 609-737-0949
New Mexico (36)	David W. King Room 3414, Federal Building 517 Gold Avenue, S.W. Albuquerque, New Mexico 87102 Commercial: 505-766-2462 FTS: 474-2462 (***) MDT: 8:00 a.m. to 4:30 p.m.	P.O. Box 85 Stanley, New Mexico 87056 Tel: 505-832-4982

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New York (37) Virgin Islands (64)	Karen N. Hanson Room 871 U.S. Courthouse & Federal Building 100 South Clinton Street Syracuse, New York 13202 Commercial: 315-423-5290 or 5312 FTS: 950-5290 or 5312 (***) EST: 8:00 a.m. to 4:30 p.m.	1254 E. Lake Road Middlesex, NY 14507 Tel: 315-584-6616
North Carolina (38-39)	James T. Johnson Room 514 310 New Bern Avenue Raleigh, N.C. 27601 Commercial: 919-755-4640 FTS: 672-4640 (***) EST: 8:00 a.m. to 4:30 p.m.	Box 28 Harrells, NC 28444 Temporary Residence: 1005 St. Mary's Street Raleigh, NC 27605 Tel: 919-832-0809
North Dakota (40)	Frederick S. Gengler Room 208, Federal Building Third and Rosser Bismarck, North Dakota 58501 P.O. Box 1737 Bismarck, North Dakota 58501 Commercial: 701-255-4011 plus Ext 4237 or 4235 FTS: 783-4235 (***) CST: 7:45 a.m. to 4:30 p.m.	1707 So. Third Street Bismarck, N. Dakota 58501 Tel: 701-258-2739
Ohio (41)	Gene R. Abercrombie Federal Building, Room 507 200 North High Street Columbus, Ohio 43215 Commercial: 614-469-5606 FTS: 943-5606 (***) EST: 8:00 a.m. to 4:30 p.m.	7845 Livingston Road Cincinnati, Ohio 45239 Tel: 614-457-3492
Oklahoma (42)	Gene F. Earnest USDA Agricultural Center Bldg. Stillwater, Oklahoma 74074 Commercial: 405-624-4250 FTS: 728-4250 (***) CDT: 8:00 a.m. to 4:30 p.m.	1805 Liberty Avenue Stillwater, OK 74074 Tel: 405-624-3703

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Oregon (43)	Kenneth Keith Keudell Room 1590 Federal Building 1220 S. W. 3rd Avenue Portland, Oregon 97204 Commercial: 503-221-2731 FTS: 423-2731 (***) PDT: 8:00 a.m. to 4:30 p.m.	120 S.W. 85th Street Portland, Oregon 97225 Tel: 503-292-6519
Pennsylvania (44)	J. Fred King Federal Building, Room 728 228 Walnut Street P.O. Box 905 Harrisburg, Pennsylvania 17108 Commercial: 717-782-4476 FTS: 590-4476 (***) EST: 8:00 a.m. to 4:30 p.m.	3730 Marlborough Way College Park, MD 20740 Tel: 301-935-2927
Puerto Rico (63)	Juan Jose Jimenez Federal Building Carlos Chardon Street Hato Rey San Juan, Puerto Rico 00918 G.P.O. Box 6106G San Juan, Puerto Rico 00936 Commercial: 809-753-4308 FTS ASSISTANCE OPR: 967-1221 (***) AST: 7:30 a.m. to 4:15 p.m. (NOTE: From the National Office Dial 9-472-6620 - Give Operator FTS number 809-753-4308)	J-6 Bilbao Street Villa Clementina Guaynabo, PR 00657 Tel: 809-789-7091
South Carolina (46)	Karl G. Smith 240 Stoneridge Road Columbia, S.C. 29221 P.O. Box 21607 Columbia, S.C. 29221 Commercial: 803-765-5876 FTS: 677-5876 (***) EST: 8:10 a.m. to 4:50 p.m.	Box 368 Lake City, SC 29560 Tel: 803-256-3269

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Tennessee (48)	Earl W. Avery 538 U.S. Court House Building 801 Broadway Nashville, Tenn. 37203 Commercial: 615-251-7341 FTS: 852-7341 (***) CST: 8:00 a.m. to 4:30 p.m.	1117 Mac Arthur Drive Brentwood, Tenn. 37027 Tel: 615-790-1022
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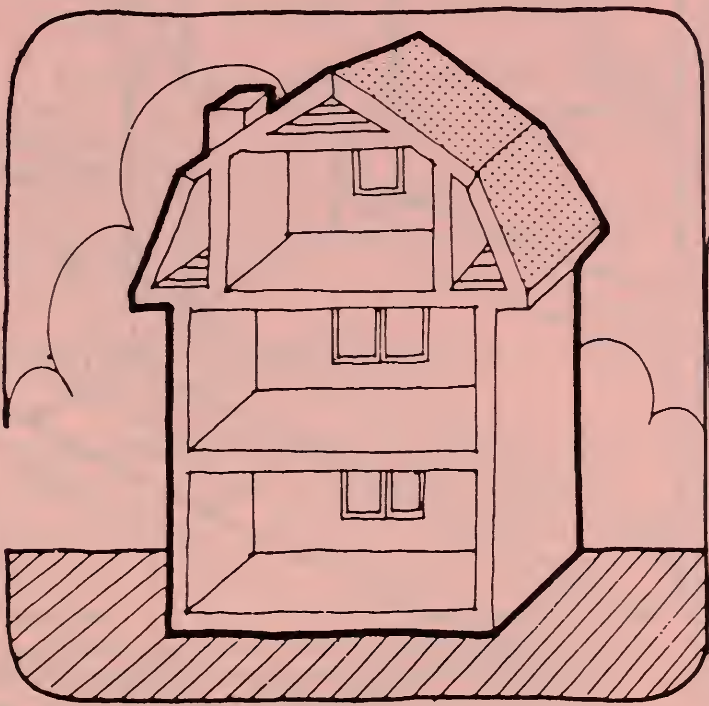
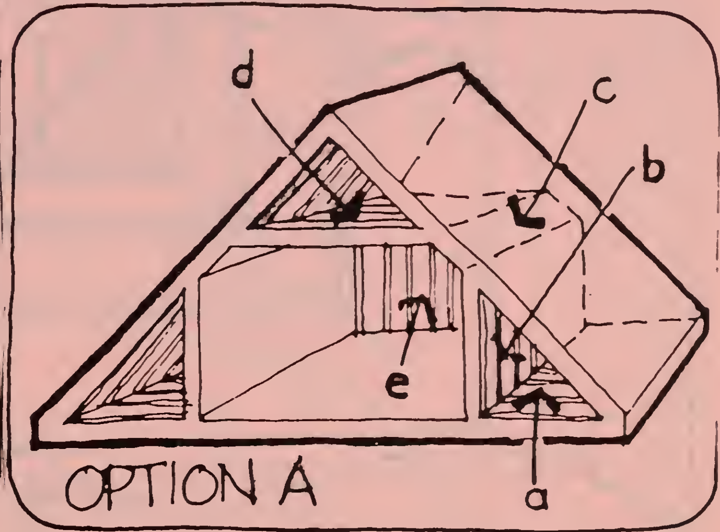
Complications: The 1 1/2 And 2 Story House



These buildings can be difficult! Insulation should be applied in either of two ways in order to create a complete heat-retaining envelope:

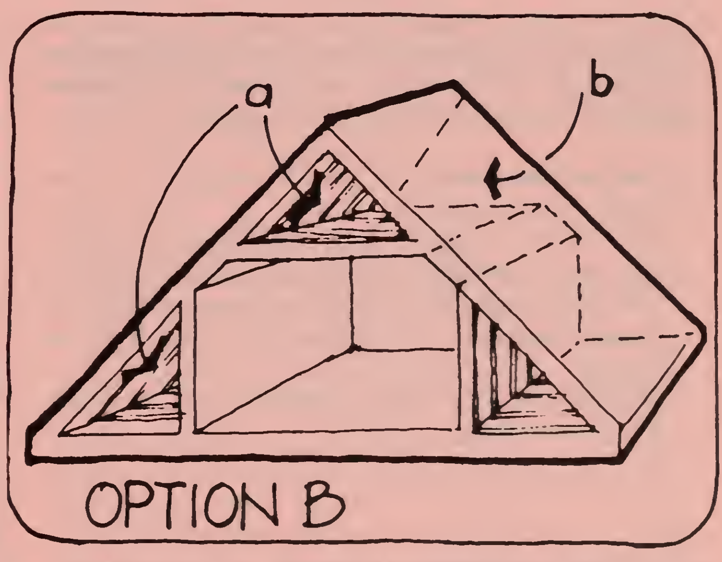
Option A

a) outer attic floor
b) the so-called "knee-wall"
c) short section of rafters
d) attic ceiling
e) end walls of attic room



Option B

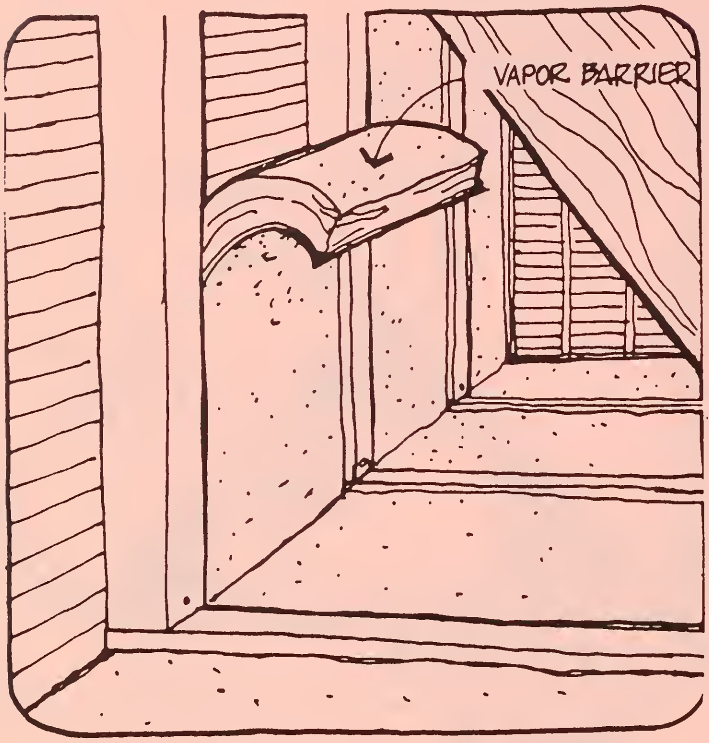
a) full length or rafters
b) complete end walls of house



Method A is the preferred insulation program, since it cuts down on potential moisture problems, produces a more comfortable room (warmer walls), and reduces the total space to be heated.

If you can get into these spaces to work, you can do-it-yourself. Otherwise, a contractor will likely be necessary.

1) Treat the outer attic floor and the attic ceiling (designated (a) and (d) in figure A above) exactly as described for standard, unfinished attics on the previous pages.



— if batts with attached vapor barriers are being used, then special care should be taken at the joint with the outer attic floor and at the joint with the attic ceiling. An additional strip of polyethylene should be applied to seal the joint, as illustrated.

— if there are any electrical outlets (careful!) or pipes in the knee wall, then make sure you keep them on the warm side ot the vapor barrier and insulation.

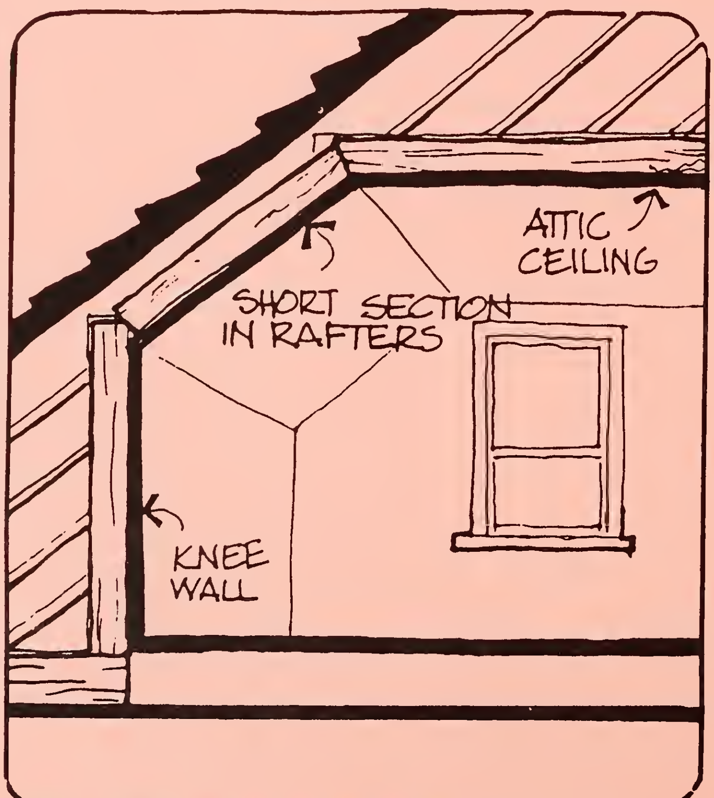
The knee wall (designated (b) in figure A) should be treated in much the same way as the unfinished attic floor described on the previous pages, making appropriate allowances for the fact that it stands upright:

— batt insulation should be used in preperence to loose fill (for obvious reasons).

— rigid foam insulation could theoretically be used. However, in confined attic spaces, batts are likely to be much more easily handled (and less expensive!).

— before beginning, any obvious air leaks should be caulked.

— the vapor barrier should be applied on the warm side of the insulation.



The section in the rafters (designated (c) in figure A above) may be filled right up with insulation if:

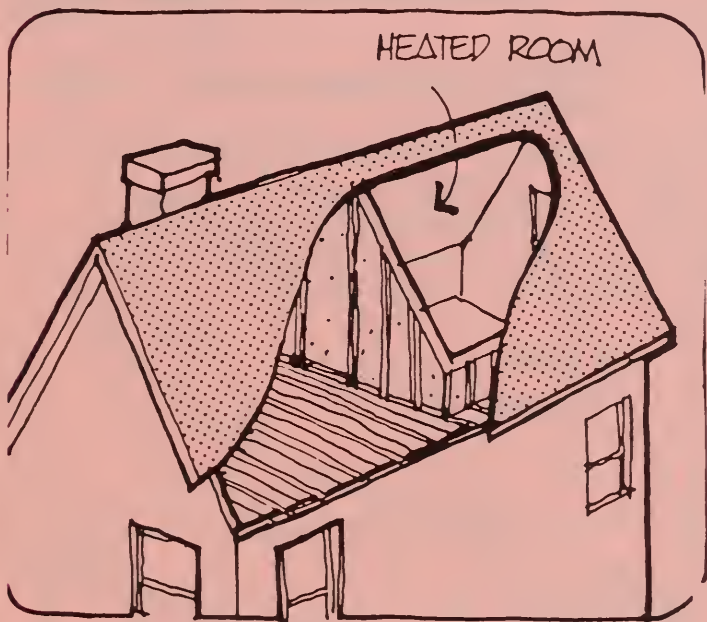
—you currently have no moisture problems,
— you have sealed as many air leaks into the attic space as possible,
— humidity levels in your house are not excessive

If, however, you are unsure about whether or not moisture in the attic will be a problem, you should probably leave some ventilation space between the insulation and the roof above it.

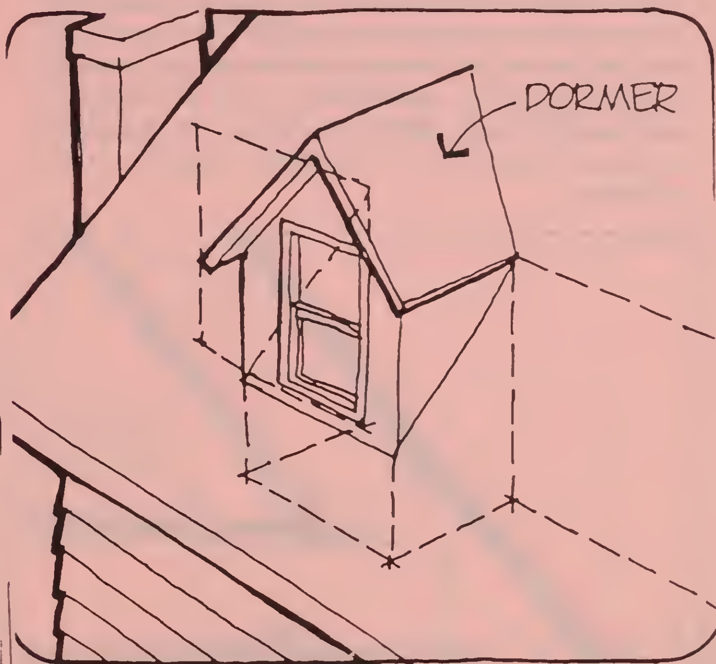
Remember to place the vapor barrier on the inward side of the insulation, making it nearly continuous with the barriers above and below.

OTHER Complications

Some houses will have a wall in the attic that adjoins a heated space. Insulate it as you would knee wall



— Many houses with accessible attics also have dormer windows.
—the walls shaded in the illustration may be insulated with batt insulation, as described for the knee wall. As always, the vapor barrier should be on the heated side of the insulation, overlapping at joints and corners.



—the remaining walls and the dormer ceiling are much more difficult. A contractor may be able to re-insulate it for you. If you're having a contractor do work on the walls anyway, it may be worth your while to have the dormers done at the same time.

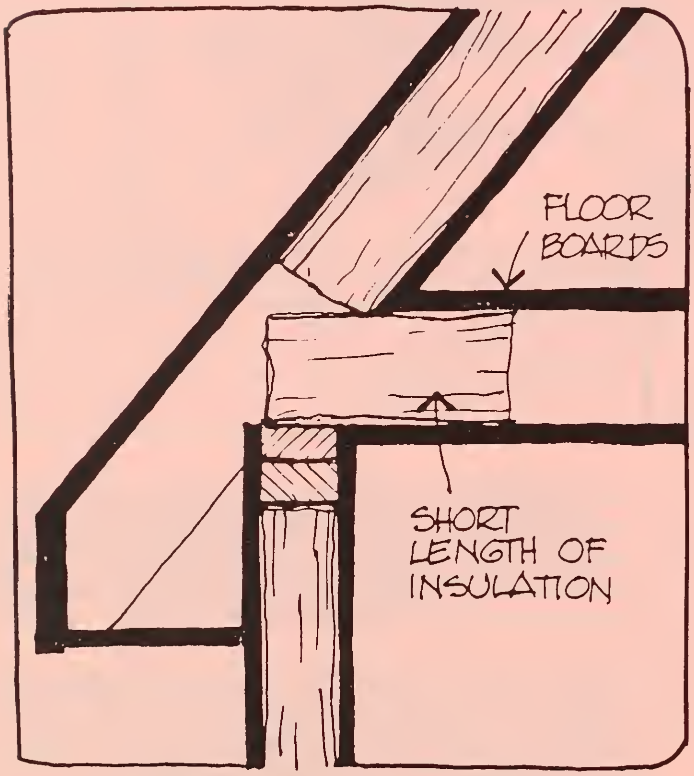
— Some houses will have the attic floored over, even though it's not used as living space.
— you can re-insulate it yourself by lifting the floor boards and treating it as you would an unfinished attic.
— you can have a contractor blow loose insulation through a few small holes into the sub-floor space, completely filling it up. Choose the contractor with care. Before he begins, calculate the R-value that you expect to achieve, given the space between the attic floor and the ceiling below. Then, check the bags of insulation to be used. They should indicate what area one bag will cover at the selected R-value. You and the contractor should then agree on the total number of bags to be used. There is no way of installing a vapor barrier in this case. If one does not exist, it should be acceptable to install the insulation if the following conditions are met (even if there is a vapor barrier, these conditions are worthwhile!):

1) there is no evidence of existing moisture problems
2) humidity sources in the house are reasonable

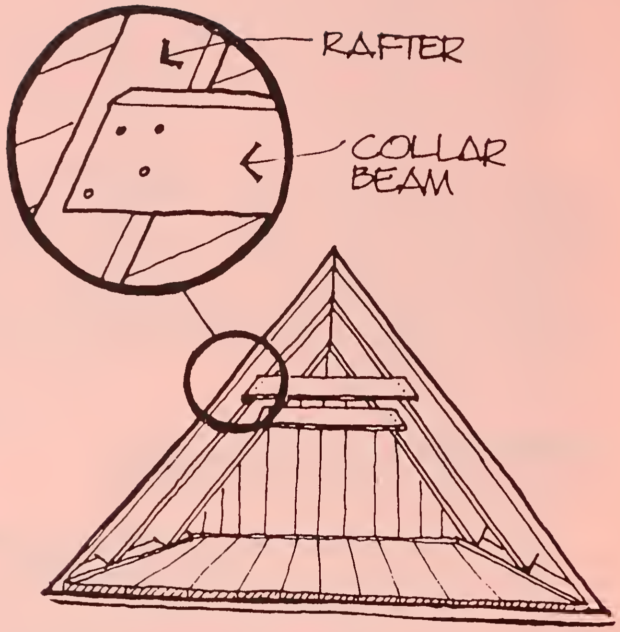
3) the floor above the insulation will allow air to pass
4) an effort has been made to plug all air leaks into the attic from the house below
5) the attic is adequately ventilated

When there is no vapor barrier, added protection can be achieved by painting the underside of the ceiling with a coat of spar varnish or two coats of oil based paint.

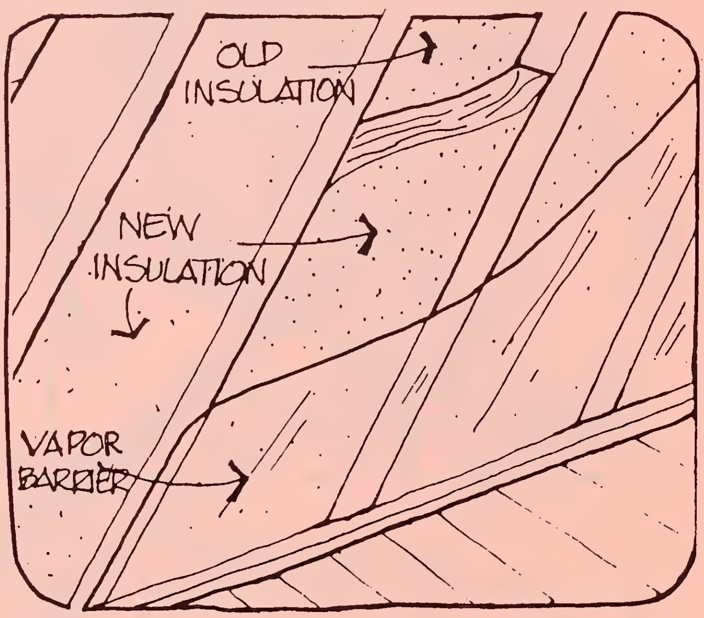
— If you expect to finish your attic some day, you may want to insulate between the rafters instead. Just remember that the process is somewhat difficult and may create moisture problems. Furthermore, until you actually start using the attic, you'll be heating a lot of unused space. If you choose to do it, the steps to take are briefly as follows:



1) The wall space immediately below the attic floor must first be insulated. This will be easy if the floor boards can be lifted. Simply pack the space with batt type insulation as shown.

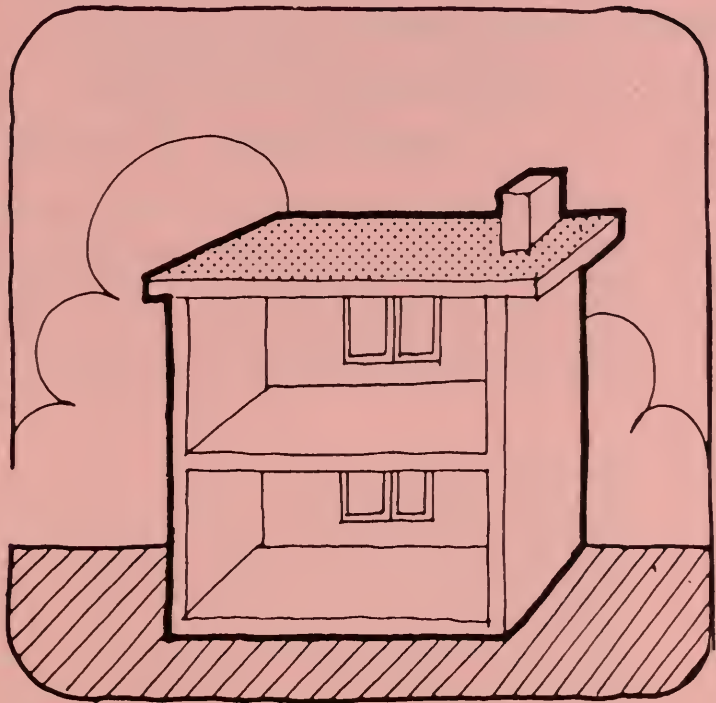


2) Install collar beams between every pair of rafters, as illustrated.

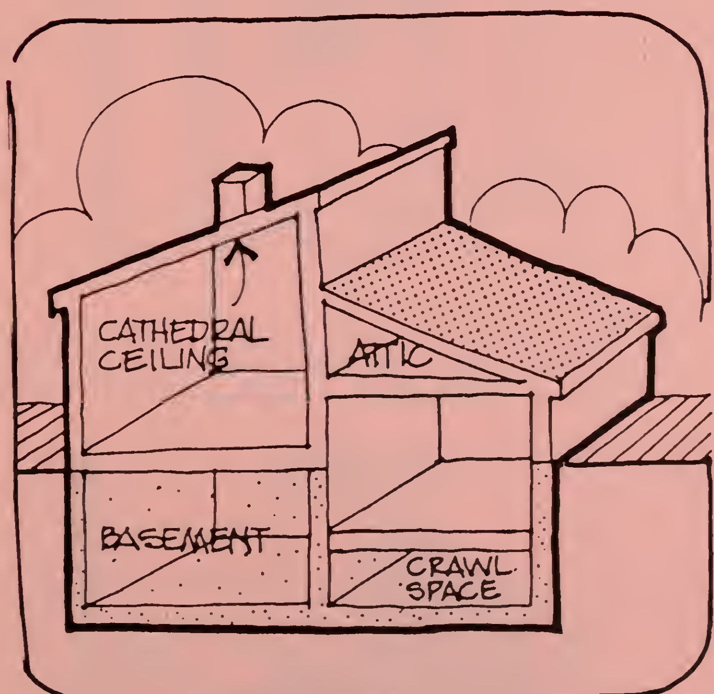


3) If there is already some insulation between the rafters and between the end wall studs, move it to the back of the rafter or stud space, and destroy the vapor barrier. Next, apply the new insulation (it should be either glass or mineral fiber ''friction fit'' batts) as illustrated. Finally, staple a continuous polyethylene vapor barrier to the rafters and studs.
4) Insulation between the collar beams is applied from below in much the same way, with a continous polyethylene vapor barrier applied last. If, however, the collar beams were there before this operation and already been insulated, and if there is access to the upper portion, then the space may be re-insulated like a normal attic.
5) Finally, block off and seal any ventilation into your attic, which is not heated!

There Really Is No Attic



A house (or any portion of a house) with a flat roof, a cathedral ceiling, or some other "atticless" construction is likely to be a difficult case, almost certainly requiring the services of a qualified contractor. Three options are available:



a) If the roof has exposed joists or beams (usually left exposed for decorative purposes) it may be possible to close the space in, creating a new ceiling. Framing may need to be added; then insulation batts; next an extremely effective vapor barrier, blocking virtually all air flow; and finally the new ceiling. If there is an existing vapor barrier, it may cause problems unless it is destroyed or the new barrier below is much more effective than the original. In all cases, moisture could cause difficulties in such a project.

b) The existing space between the ceiling and roof can be blown full of loose fill insulation by a contractor. Since this eliminates any ventilation altogether, it is not generally a recommended practice for existing homes. If you do choose this insulation program, make sure air leaks into the ceiling are sealed and the vapor barrier is intact. Have the contractor blow in cellulose fiber (because of its high density) at a density of 3-4 lbs. per cubic foot.

c) Insulation may be added on top of the existing roof. This option is likely best, and is particularly attractive if the existing roofing needs replacing. It should, nevertheless, be undertaken by a qualified roofing tradesman.

The job can be done in a number of different ways, using a number of different materials. However, the most suitable insulation material is generally extruded polystyrene. Consult with your roofing contractor regarding the best approach for your house.

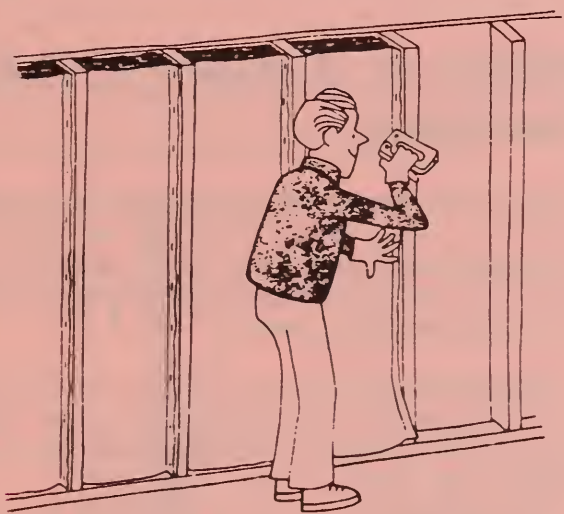
ENERGY CONSERVATION BULLETIN 1.2B.1
How to Insulate (Walls)

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton blvd Littleton Colo 80160

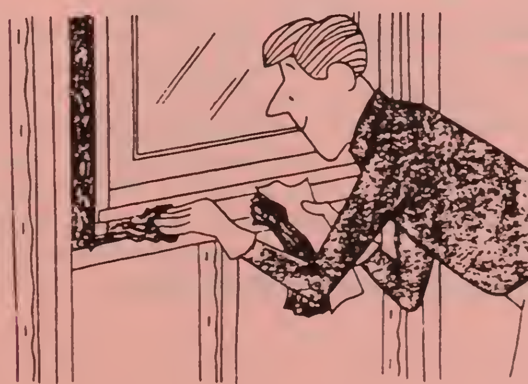
Option A: Wall Batts

FIGURING HOW MUCH INSULATION YOU'LL NEED
First, calculate the overall area to be covered — multiply the length by the width. Then adjust this number to allow for the area taken up by joists or studs. If joists or studs are 16 inches apart, multiply by .90. If they are 24 inches apart, multiply by .94. The anwer is the number of square feet of insulation you'll need.

To insulate a wall, fit the end of a blanket snugly against the top piece of framing. Working down, staple the flanges to the sides or the faces of the studs. (With aluminum foil-faced blankets, staple to the sides to create an air space, which is necessary for the heat-reflective value of the foil to be achieved.) Space the staples about 8 inches apart. Cut the blanket to fit tightly against the framing at the bottom. If more than one piece of blanket is used in the same stud space, butt the ends tightly together. The vapor barrier must face the side of the wall that is heated in winter.



Cracks and very narrow spaces, such as those around window frames, should be stuffed by hand with loose insulation and covered with a vapor barrier.



To insulate stud spaces that are narrower than normal, cut the insulation about 1 inch wider than the space to be filled. Staple the remaining flange, then pull the vapor barrier on the other side to its stud and staple through the barrier.

Walls can be insulated with unfaced blankets and a separate vapor barrier, either 2-mil-or-thicker polyethylene sheeting or foil-backed gypsum board. Keep polyethylene taut as you apply it. Staple it in place.

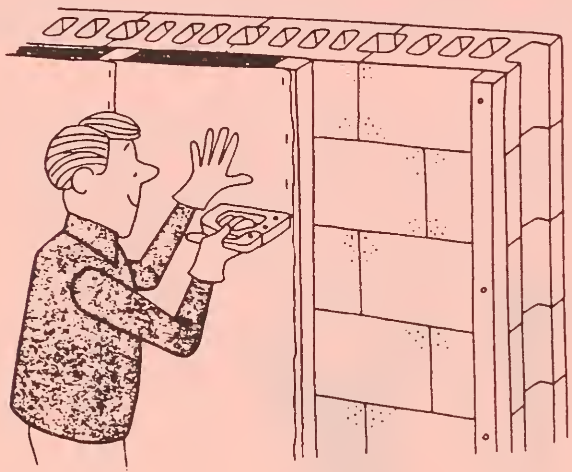
Install insulation behind pipes and ducts (to keep them warm) and behind electrical boxes. Spaces of this sort also may be hand-packed with loose insulation. To get loose wool, pull pieces from a blanket.

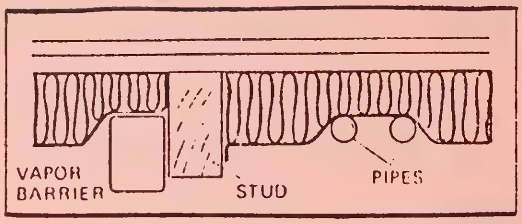
DO patch the vapor barrier of wall insulation if it has been torn. Strip a piece of vapor barrier from a scrap section of blanket or use polyethylene, taping the patch to secure it.

DON'T allow gaps, or "fishmouths," at vapor barrier edges when you are insulating walls. Keep the edges tight against the studs.

Masonry walls, basement walls and the like, are insulated by first fastening 1x2, 2x2, or 2x4 furring strips in place vertically. They should be placed 16 or 24 inches from the center of one strip to the center of the next.

With 1x2 furring, use special "masonry wall" blanket insulation (an unfaced material, of about an R-3 rating, which should be covered with polyethylene for foil-backed gypsum board to provide a vapor barrier). With 2x2s or 2x4s, install R-7 or R-11 blanket insulation as in any other wall.





IF OBSTRUCTIONS - ducts, pipes, and the like - are located in the wall cavities, push insulation behind (to the cold side in winter) those pipes before stapling. Or you can pack the space with loose insulation or cut a piece of blanket insulation to fit the space. If you do pack the space with loose insulation, make certain you cover it with 2-mil-polyethylene

NOTE: If there is evidence of existing moisture problems in your wall, make sure that you deal with them first, before adding insulation. Check for leaks where water might enter from the outside or where air might enter from the inside.

Option B: Loose Polystyrene

If your house has a wall space which opens into the attic and if the space is continuous right down to the foundation (check it with a weight on a string), then you can simply pour loose polystyrene (the shredded variety will be cheaper than the beads) into the wall cavity. Make sure you fill each stud space right to the top.

— Some of the spaces are certain to be interrupted by windows or some other obstruction. In such a case, it will be necessary to have the lower portions blown full by a contractor. The cost of this will be minimal when compared to the cost of doing an entire house by this method.

— Since it is not possible, by this method, to install a vapor barrier, you should endeavour to seal all air leaks from the inside of the house into the wall space.

You should also be careful not to develop excessive humidity in the house. Finally, further protection can be achieved by painting the inside of the wall with spar varnish, or two coats of oil-based paint.

— Any partial obstructions in the wall space (wires, pipes, etc.) can prevent the insulation from completely filling the cavity. Any "jam-ups" around these barriers can generally be loosened by beating on the inside wall at the appropriate point! In many cases, it is recommended that you go up into the attic a couple of times over the next few months, to check for settling. If there is any, re-fill the spaces to the top again.

Option C: Foamed In Place Insulation

The cavity in wood frame houses and in some masonry walls (i.e. stone, brick etc.), can be filled with foamed-in-place insulation. The material is injected into the cavity as a semi-liquid foam, which quickly solidifies to give a solid insulation material.

The polyurethane foams now available on the market are not recommended for this application as they expand greatly in the wall cavity, causing possible bursting or warping of the walls.

Urea formaldehyde foam may be acceptable, however, a number of formulations are subject to shrinkage, degradation and moisture problems. You should consider this approach only if the contractor is prepared to guarantee his work in writing, accepting liability for any damage done to the house by the insulation.

Application procedures and comments are similar to those offered below for blowing in loose fill insulation. However, special attention must be paid to moisture, since the foam contains 1½ to 3 lbs. of water per cubic foot. As it dries out, the moisture must escape from the wall — otherwise it can cause serious problems. The situation is much less serious in masonry walls, since they are less affected by water. Nevertheless, precautions need to be taken to ensure that problems do not arise.

Option C: Blown In Insulation

If you have hollow or almost hollow wood frame walls then you can have a professional insulation contractor blow in loose fill insulation. This is the most common means of reinsulating an exisiting wall. Before you proceed, however, remember that the stud space is likely only about 3½ inches thick. If there is already a couple of inches of insulation, the benefits of blowing in more will be small. It might be preferable to invest the time and money on other parts of the house.

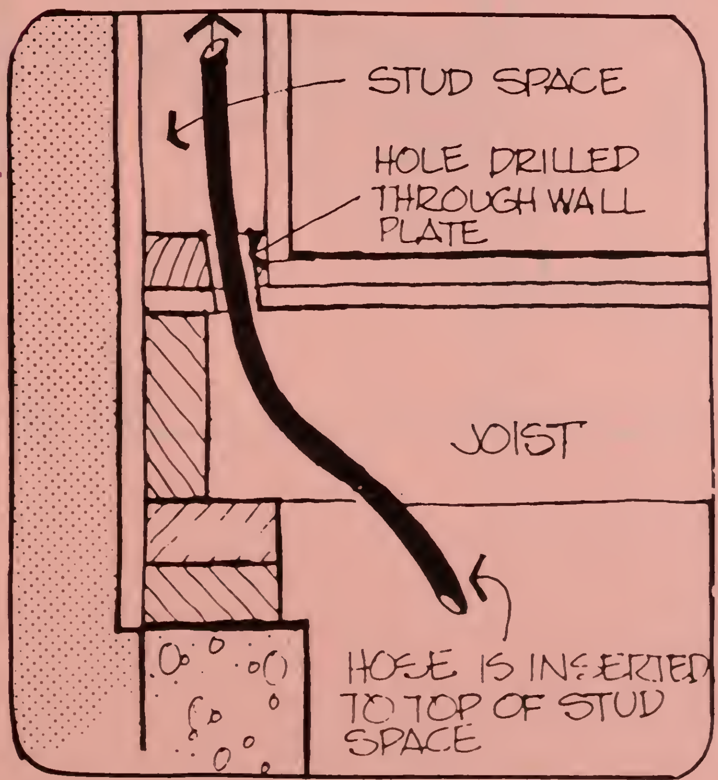
If you decide to proceed, choose the contractor carefully. You won't get a worthwhile return if the contractor cuts corners.

An access hole must be drilled into each stud space in the walls; in some cases two are needed. There are four possible ways of doing this:

1) FROM THE INSIDE WALL: This is to be discouraged in cases where there is an existing vapor barrier, as the drilling will destroy that barrier.

2) FROM THE OUTSIDE WALL: Most types of exterior siding can be drilled and then patched with little or no evidence of the work. Brick sliding can have single bricks temporarily removed. Make sure the installer patches the individual holes as he moves, rather than leaving them all until the end. Otherwise you may end up with several rain holes in your wall when that flash storm hits!

3) FROM THE BASEMENT: This can be the easiest approach. A long tube is inserted to the top of the stud space, and then withdrawn as the space fills. The pressure packs the material from the top down.



4) FROM THE ATTIC: In a similar manner, a hole can be drilled in the top place of the wall. A hose is then inserted from the attic, down the wall. As the space fills, it is withdrawn.

All spaces in the wall need to be filled — fire breaks, cross braces, and other obstructions in the wall cavity need to be allowed for. It is worthy to note that cellulose fiber in a blow-in application will more readily fill irregular spaces than the other materials. Carefully choose the insulation to be used in consultation with the contractor.

When you have settled on the material, figure out how much should be used. The bags of insulation will indicate on them how many square feet each should fill to give the required R-value. Make sure the information used is for wall applications. Knowing the size of the wall to be filled, you and the contractor should agree on the number of bags to be used — and write it into the contract. Only a small variation from the target is acceptable. If he uses too little, you will find that the insulation settles, leaving gaps in the wall. If he uses too much, some of the insulation may be escaping from the wall into a floor space or some other area where it is not needed — a big waste! So make sure the right amount is used.

If there is no vapor barrier, it may still be possible to proceed, since the insulation itself helps restrict air flow. Cellulose fiber blown in at high density is particularly effective in this regard. At the same time, an active program to seal all air leaks into the wall and cut down on humidity sources should be undertaken.

DO paint interior walls as a substitute vapor barrier if you are having a contractor install blowing insulation. Use two coats of vapor-resistant paint and brush them in well. (Paints vary widely in the rate at which they allow water vapor to pass through. Ask a paint dealer about the "perm rating" — vapor permeability rating — of the paint he carried. A rating of 1 perm or less for primer and finish coat combined is considered good. If the dealer doesn't know about perm ratings, ask him to check with the manufacturer.)

Compare your needs with the various available options, and choose the one that seems most suitable. In a majority of cases, that will be blowing in insulation. The investment will be fairly high, but remember that it will be recovered in time. After that, it is money in the bank for you — and you have a better house for it!

Option D: Wall Renovation

If your plans permit extensive renovation, you have two options:

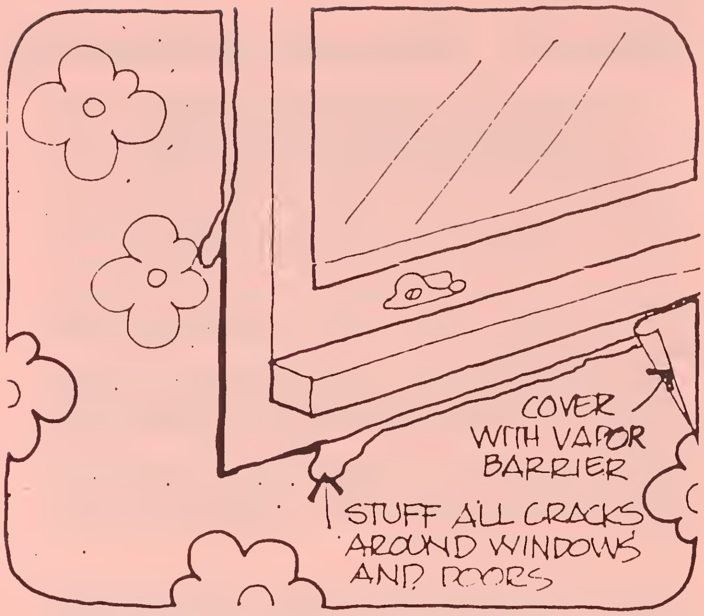
1) REBUILD THE EXISITING WALL: With wood frame house only, you may remove the wall board or plaster already in place and re-insulate the wall. While you are at it, you may want to attach 1x2'' or 2x2'' strips to the stud edges to allow for more insulation in the wall cavity.

2) BUILD A NEW WALL INSIDE THE OLD: With both wood frame and masonry walls, you may build a new wall inside the existing one, and then insulate it. This approach is only possible if there is no vapor barrier in the exisiting wall, or, if there is, its effectiveness can be reduced (by cutting for instance).

— Rigid foam, fiberglass or mineral fiber batt insulation may be used for this type of application.

— when installing a separate polyethylene vapor barrier, unroll the sheet across the entire wall area, including window and door openings. These can be cut out later.

— make sure the insulation and barrier extend behind any pipes, electrical boxes, etc., such that these obstructions are on the warm side of the insulation. This may be difficult when building new inside walls. Electrical boxes may be moved into the new wall by a qualified tradesman or they might simply be inactivated and left on the cold side. Pipes are more difficult. If there are any in your existing wall (follow them up from the basement and down from the bathroom and kitchen) they could freeze and burst if left outside the insulation. Try to somehow get behind them, rather than in front. **If this isn't possible, then don't insulate using the new wall approach.**

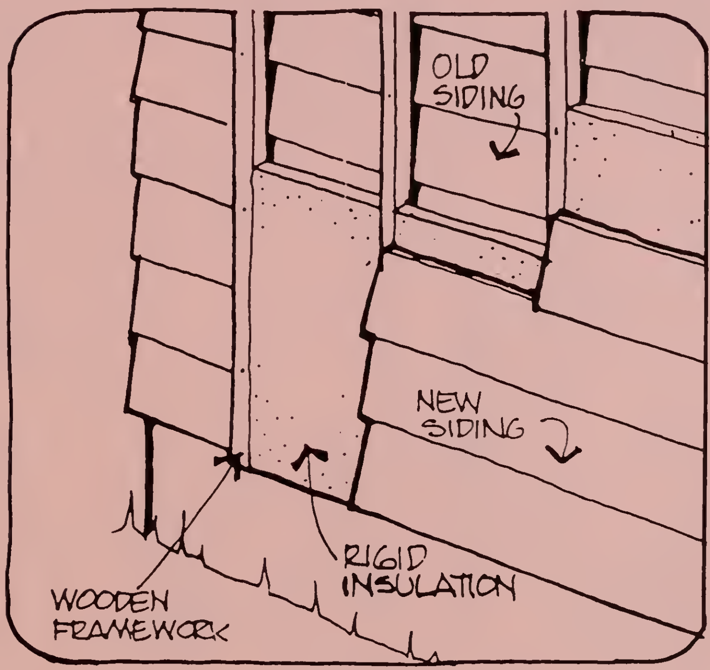


— If you are rebuilding the exisiting wall, be sure to stuff all cracks around doors or windows with insulation or oakum (a material used specifically as a filler, available from your building materials suppler). Cover the cracks with a vapor barrier. If installing a new wall, frame around the windows and doors as illustrated.
For non-standard stud spaces, cut the insulation (if the batt type is used) and any attached vapor barrier to about an inch wider than the space to be filled.

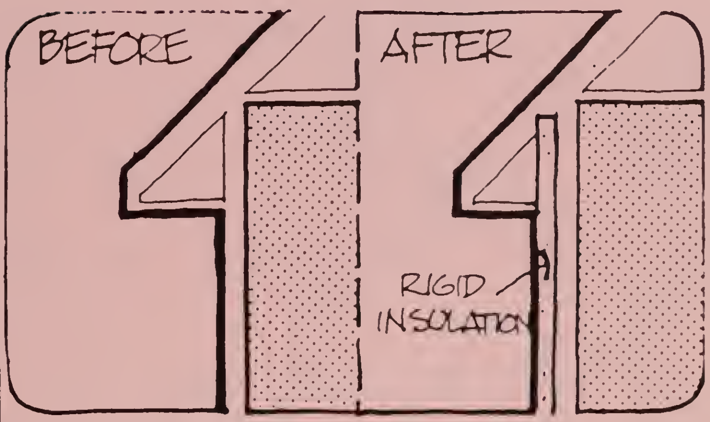
Option F: Insulate Outside

If you are installing new siding on the house in any case, it may be worthwhile to install polystyrene over the old siding, but under the new. A few points to keep in mind:

- •extruded is the best option but a high density expanded polystyrene will be satisfactory.
- •a wooden framework should be built over the entire outside wall to position the insulation and support the new siding.
- • no vapor barrier should be added.



•unless the old siding supplies a good surface for glueing, the polystyrene should be nailed in place.



•the insulation should be extended right to the top of the wall, which may require going up into the eaves, as illustrated.

•if this does not prevent water from getting in between the insulation and the siding, then you must add "flashing" at the top of the insulation for this precise purpose. Consult with your building materials supplier.

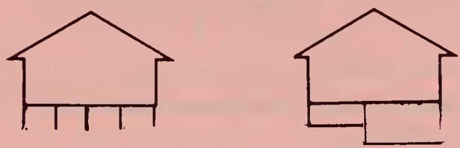
ENERGY CONSERVATION BULLETIN 1.2C.1
How To Insulate (Floors and Basements)

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

There are two cases where it's good to insulate your floor:

1. You have a crawl space that you can't seal off in winter — for example, your house stands on piers:

2. You have a garage, porch, or other cold unheated space with heated rooms above it:

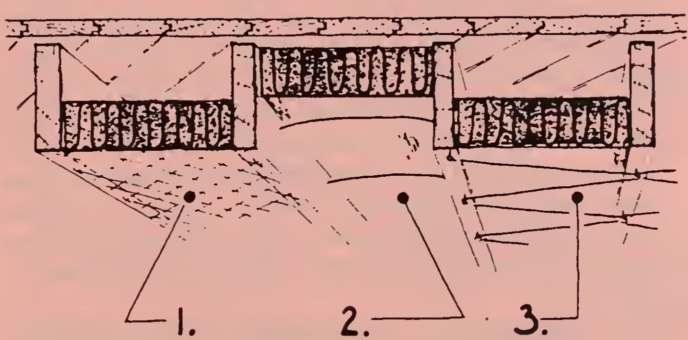


FLOOR INSULATION — GENERAL — Warm side vapor protection is recommended.

Place the insulation with the vapor barrier facing up in all applications except where a vapor barrier paper is used in place of the building paper over the sub floor. Only in this application may the vapor barrier face down.

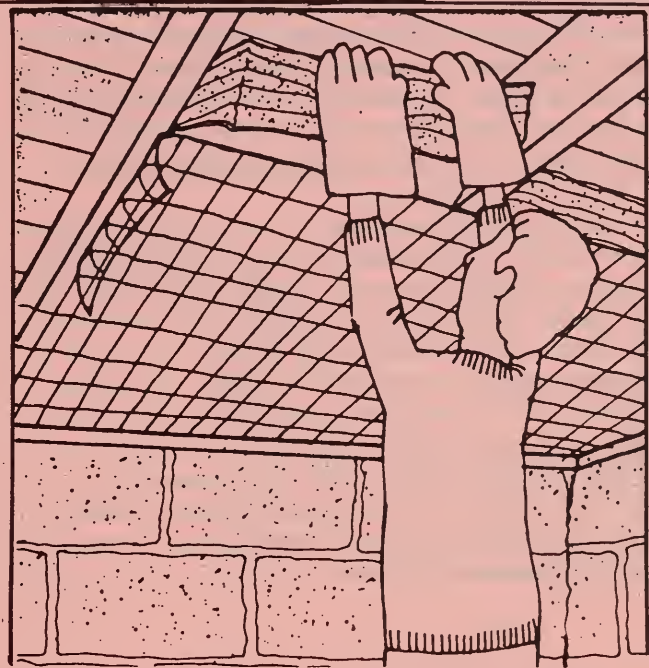
Typical methods of supporting floor insulation are shown below.

1. Chicken wire stapled to the edges of the joists, supporting the insulation above.
2. Commercially available fasteners made of heavy gauge wire, pointed at both ends. Slightly longer than the

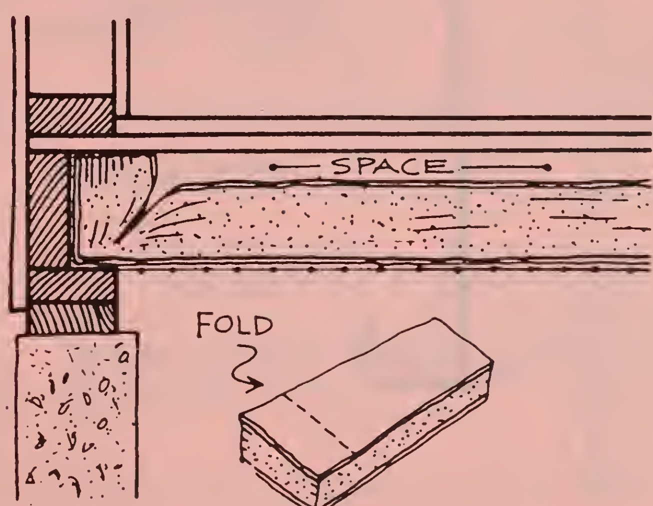


spacings between joists, they are bowed slightly and snapped into place.
3. Wire (preferably rustproof), either stapled in place or laced around galvanized roofing nails driven in the edges of the joists.

Reversed flange material may be used as floor insulation and may be stapled from below. If the vapor permeable face toward the crawl space is non-reflective, additional support may be required.



Start at a wall at one end of the joists and work out. Staple the wire to the bottom of the joists, and at right angles to them. Slide batts in on top of the wire. Work with short sections of wire and batts so that it won't be too difficult to get the insulation in place. Plan sections to begin and end at obstructions such as cross bracing.



Buy insulation with a vapor barrier, and install the vapor barrier facing up (next to the warm side) leaving an air space between the vapor barrier and the floor. Get foil-faced insulation if you can; it will make the air space insulate better. Be sure that ends of batts fit snugly up against the bottom of the floor to prevent loss of heat up end. Don't block combustion air openings for furnances.

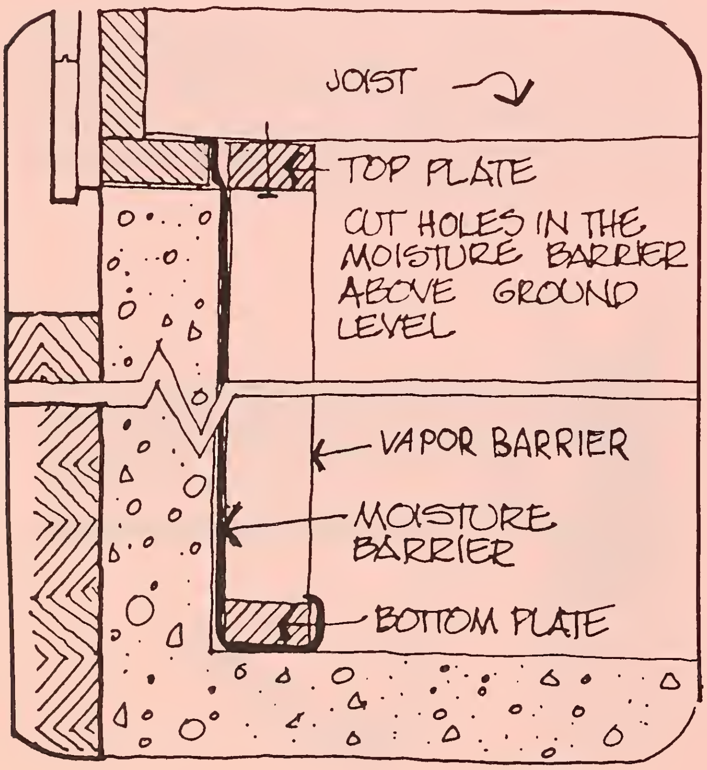
How To Insulate (Basement)

BASEMENT INSULATION —

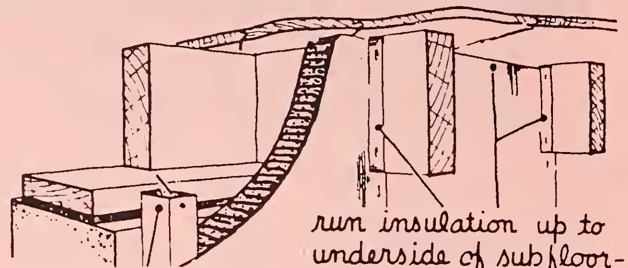
If you have a basement that you use as a living or work space and that has air outlets, radiators, or baseboard units to heat it, you may find that it will pay to add a layer of insulation to the inside of the wall.

Finish with wallboard or panelling. Basement walls are readily insulated by fastening furring strips vertically against the walls, and fitting batt or blanket insulation between them. Staple the flanges of the insulation to the furring strips just as though they were regular studs.

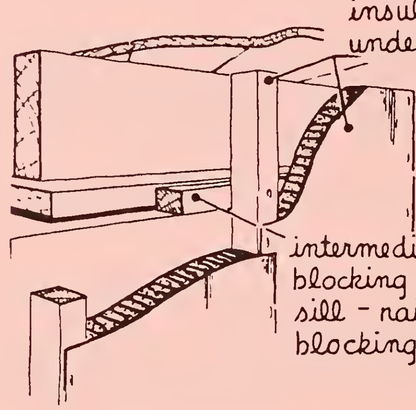
If the walls ever become damp, then the portion below ground should, as a minium, be treated with water-proofing chemical before proceeding. Even better, cover that same portion with a 2 mil polyethylene moisture barrier. The easiest way to install such a barrier is to attach the polyethylene to the header joist at the top. The portion of the barrier above ground can then be partially cut away to allow any moisture which might become trapped in the insulation to escape. Next, extend the sheeting right to the floor, such that the bottom edge stretches under the bottom plate of the framework, then back up to attach to the top of the place, as shown.



The figure below shows how furring strips can be attached at the top of walls parallel to the floor joists above.



The figure below shows how the tops of furring strips can be attached to the joists themselves when walls run at right angles to the joists.



The bottom of furring strips must also be fastened, either to the walls by drilling and inserting fiber or lead plugs to hold a nail or screw through the furring strip, or by attaching a plate to the floor at the bottom of the walls by similar means and toe-nailing the bottom of the furring strips to it. The plate and the furring strip should be of the same depth. The insulation between the furring strips should be fitted snugly against the sub-floor at the top, and against the basement floor or plate at the bottom.

Where all the walls of a basement area are insulated, it is not necessary to insulate the ceiling above that area, but any portion of the basement without complete wall insulation should have the ceiling above that area insulated.

ENERGY CONSERVATION BULLETIN 1.2C.3
How To Insulate (Outside of the Basement)

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

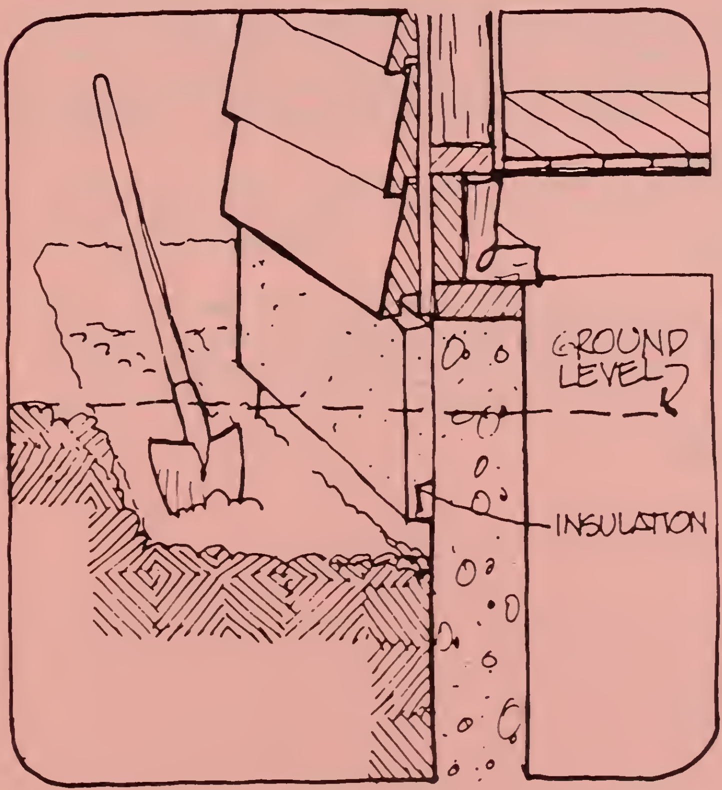
TYPE OF INSULATION

There is really only one choice — rigid extruded polystyrene. This product must be distinguished from the white board which is commonly called "styrofoam." This is an incorrect name — the proper name is polystyrene "beadboard." The term "Styrofoam" is a registered trade mark which properly refers to a particular company's version of extruded polystyrene. This product is blue.

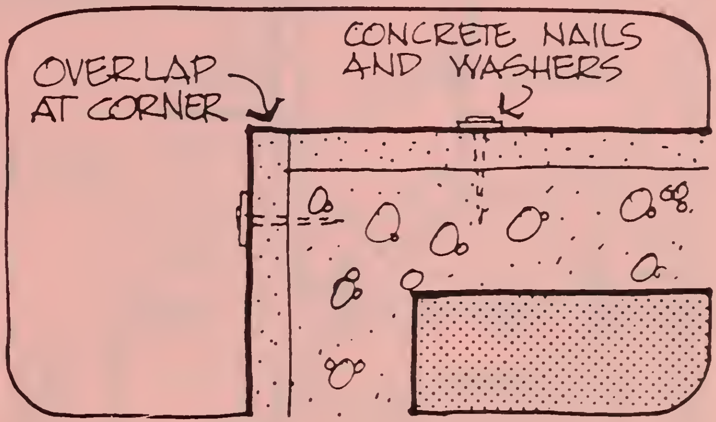
Extruded polystyrene not only has a high insulating value, but has a very high resistance to water absorption. As such, it is well suited to this purpose.

The insulation used should be at least 2 inches thick, and the horizontal section should be at least 2 feet wide. Even better would be a 3 inch thickness and a 3 to 4 foot width. The decision about what size to use should be based upon the climate and upon your personal finances.

1) **Digging the hole:** The vertical piece of insulation should extend a minimum of 12 inches into the ground. The second piece should be sloped towards the building (to promote drainage through the unfrozen soil adjacent to the basement wall) such that it drops about 2 inches for 2 foot piece of insulation or 3 inches for a 3 foot one. In short, you could be digging between 9" and 12" deep around your entire house — a big job. Don't make it bigger by oversizing your hole. You may even want to have it done by a contractor with the appropriate machinery!



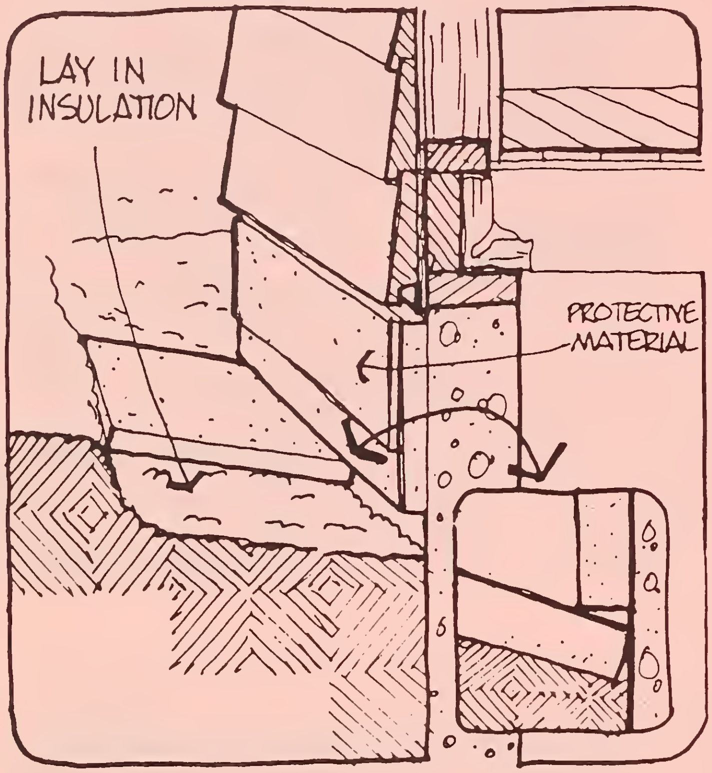
2) Apply the vertical polystyrene first, attaching it to the wall with concrete nails driven through a washer on the outer surface of the polystyrene. This job will be made easier if you drill small guidance holes for the nails beforehand. Overlap the insulation at corners.



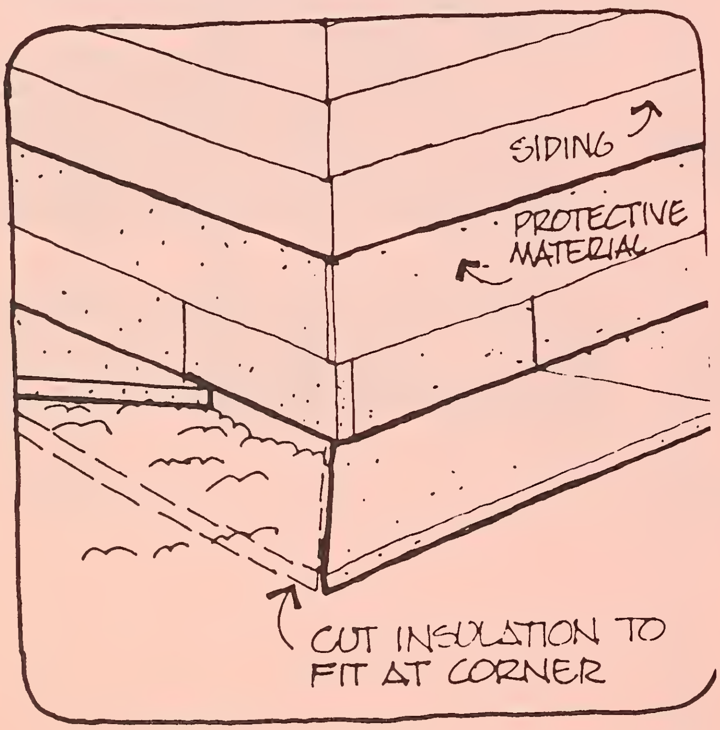
3) The exterior protection is applied next, from the top of the insulation to a point about 4 inches below ground level:
   a) if using the latex based stucco (the easiest and cheapest), simply follow the directions supplied by the manufacturer. The application is a two-stage process requiring no special skills.
   b) if using the asbestos board, you may want your dealer to cut it to size, since the material is rock hard. It must be applied using nails, as outlined above for the insulation. Remember, however, that the flashing at the top and the soil at the bottom will help to keep the board in place, so the nailing can be minimal.

4) Level off the soil in the hole so that it slopes uniformly down to the low point. A handy way of achieving this is to have a 2 x 4 of appropriate length handy. Simply drag it along the bottom of the hole, leveling off all the uneven sections.

5) Lay the insulation on the ground in such a way that it butts tightly against both the basement wall and the underside of the vertical polystyrene, as detailed in the inset.



6) At the corners, cut the insulation specially to fill the entire space, as shown.



7) Place the polyethylene plastic sheeting against the protective board and the insulation. It need not be held securely in place. Refill the hole, very gently at first so as to not damage the insulation — or the polyethylene. **Make sure the ground, when the hole is finally filled, slopes away from the house.** This will encourage drainage away from the insulation, as will the addition of eave troughing. It is important not to direct excess water towards the foundation.

8) Apply the flashing according to the manufacturer's instructions. Remember that it must be applied so as to prevent any water runoff from getting in behind the insulation.

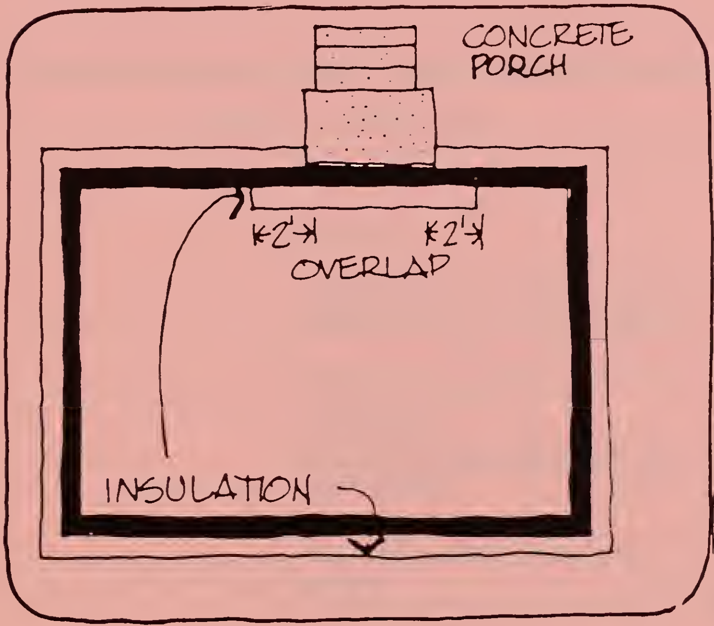
9) The filled hole may be covered with any type of surface — patio stones, grass, a garden, or whatever you please. Shrubbery with deep roots should, however, be avoided.

10) If insulation is necessary inside, between the joists, then apply it as shown for basements. Pay particular attention to keeping the vapor barrier tight. For this purpose, a separate polyethylene barrier is preferable to the type attached to the batts.

How To Insulate Heated Crawlspace

1) Insulate the outside wall exactly as directed for the outside basement wall.

2) If outside obstructions (a porch, a paved driveway, etc.) make it impossible to completely encircle the crawl space from the outside of the house, then the inside of the wall may be insulated at those points. Make sure the inside and the outside portions overlap by at least 2 feet, as illustrated.



The insulating material to use is extruded polystyrene. It should be applied in the same manner outlined for inside the basement. The job will be tricky in such cramped quarters! **In particular, remember the gypsum covering for the insulation — you'll have a fire hazard if you forget.**

3) If there is no vapor barrier on the crawl space floor, add one. The barrier should be protected by covering it with a 2 inch layer of sand.

4) If your crawl space doesn't open into a full basement it should have summer ventilation (about one square foot for every 500 square feet of floor space). Make sure these vents are closed and well sealed each winter!

How to Insulate Unheated Crawlspace

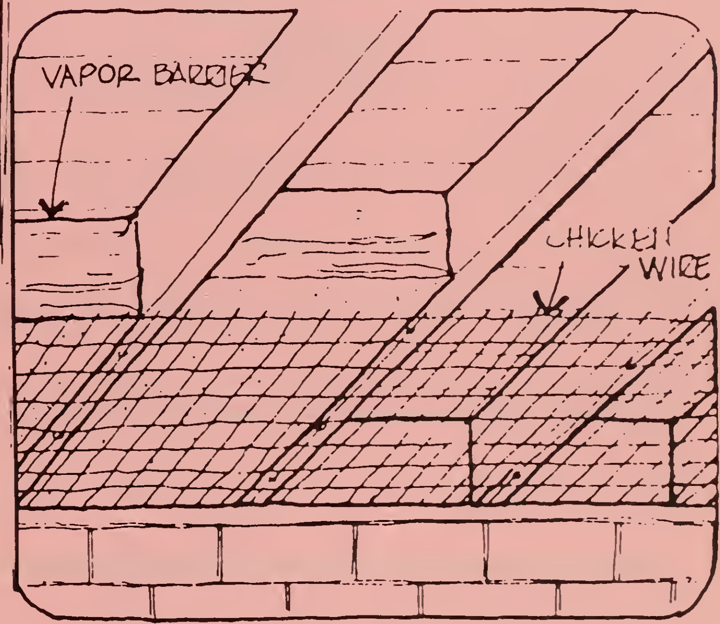
This approach should only be taken when the crawl space is moist enough to require ventilation all year round, even with a vapor barrier on the ground.

This job requires the use of batt or blanket insulation, most conveniently the type with the vapor barrier already attached.

A few points of general importance should be summarized:

1) The vapor barrier is to be applied on the warm (top) side of the insulation.

2) The insulation may be held in place by the use of building paper stapled to the joists, by chicken wire, or any other supporting material. If batts are applied separately from the vapor barrier, then they should be held firmly against the barrier, leaving no air space in between.



3) If there are any heating ducts or pipes in the crawl space, be sure to wrap them with duct insulation.

4) Make sure the crawl space is adequately ventilated. You should have at least one square foot of venting for each 500 sq. ft. of floor area.

5) Make sure there is a vapor barrier on the crawl space floor. It should be covered with a 2 inch layer of sand for protection.

ENERGY CONSERVATION BULLETIN 1.3.1
Insulation "R Values

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

An "R" value is a number indicating how much resistance insulation presents to heat flowing through it. Generally, the higher the "R" value, the more effective the insulation. Consumers should pay more only for a higher "R" value.

To help the consumer guard against dishonest contractors or salespeople who overstate the "R" value of an insulation product, outlined following are the current insulating materials:

	APPROXIMATE R-VALUE PER INCH
LOOSE FILL INSULATION	
Glass fiber	2.7 - 3.5 (pouring) 2.4 - 2.8 (blowing)
Cellulose fiber (2.1 to 2.3 lbs. density)	3.2 - 3.5
Mineral fiber* (2.0 - 5.0 lbs. density)	2.7 - 3.6 (pouring) 2.6 - 3.2 (blowing)
Vermiculite (expanded mica 7 lbs. density)	2.1 - 2.5
Loose polystyrene (shredded or beads)	3.0 - 3.3
Wood shavings	2.4
Wood wool (available in only some localities)	3.0
BATT OR BLANKET TYPE INSULATION	
Glass or mineral fiber batts	2.9 - 4.0
RIGID BOARD	
Extruded polystyrene (Roofing material, blue)	4.3 - 5.0
Expanded polystyrene "Beadboard" (white)	3.4 - 4.2
Phenolic foam board	4.2
Polyurethane slabs	5.0 - 6.0
"FOAMED IN PLACE"	
Ureaformaldehyde	4.3 - 4.9
Polyurethane foam	4.7 - 5.0

Any claim of an "R" value above the maximum design standard should be highly suspect.

Make sure you buy loose fill insulation by the bag and not by the inch. A contract should state how many bags are needed to bring the attic to a certain R-value, based on manufacturers specifications, which usually appear on a coverage chart right on the insulation bag. The depth frequently referred to is a minimum depth after the material settles. Make sure the correct number of bags are installed, even if you have to stand next to the truck and count them as they are stuffed into the blowing machine.

ENERGY CONSERVATION BULLETIN 1.4.1
Caulking and Weather Stripping

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Infiltration of outside air is a major drain on energy in the home. During the winter the incoming air, which may already have a low moisture content, must be heated, and this tends to further reduce the relative humidity in the house, creating a dry air problem. In the summer the incoming air must be cooled and usually dehumidified.

Weatherstripping and caulking play an important part in reducing infiltration. Wind can cause a buildup of pressure on a portion of the house, forcing air through even the smallest cracks. If a window is not properly weatherstripped, it may even be possible to see the curtains move when there is a heavy wind. (When the wind velocity is doubled, the air leakage increases about 4 times.) Since nearly all building materials expand and contract with changes in weather, enough clearance must be allowed for this when constructing the house. This expansion space must then be closed with some form of weatherstripping or caulking. If a door must be moved regularly, weatherstripping is usually used to seal the crack. If the crack is between two fixed portions of the house, then caulking is forced into the joint to close it.

CAULKING

If there is a gap where two materials meet, such as siding and window trim, or corner trim, any cracks must be caulked. This is primarily to keep water from penetrating the structure of the house, but it also helps to prevent air infiltration. Caulking works like chewing gum in any crack or opening to prevent wind and water penetration. The ideal caulking will adhere to both sides of the opening to be closed and remain resilient to permit movement between the two materials without cracking. Inexpensive caulking may be able to withstand only minor expansion or compression before it fails and cracks. Good caulking may withstand a great deal of expansion or contraction before failure.

Caulking should also be used to close any cracks in masonry construction, either in the siding or foundation. In brick masonry construction there are often weep holes left in the vertical mortar joints in the bottom row of bricks to permit any moisture that penetrates the wall to drain out.

Do not caulk or block the weep holes in any way. If there seems to be an air infiltration problem, a length of fiberglass rope can be stuffed into the weep hole, which will effectively block air circulation, but will withdraw any water from behind the brickwork like a wick. If the prime window in the house is relatively loose, it may be simpler to caulk the storm sash into place rather than to weatherstrip the prime one. However, in no case should the bottom of a combination storm-screen sash be caulked. When the storm panel is raised and the screen is in place, a blowing rain will penetrate through the screen, and if the bottom of the sash is caulked, the water will accumulate on the windowsill and run into the house. Most such storm-screen combinations have holes along the bottom edge to allow for drainage. They should never be plugged.

It should also be noted that caulking the storm sash into place may cause problems with condensation on the inside surface of the storm window if the storm sash is tighter than the prime one. The cure in this case is to make the prime sash tighter so that water vapor does not leak past the prime sash.

If windows will not be opened during the heating season, a special type of caulking, in the form of a coiled string, is available for one-season use, and it may easily be stripped off in the spring. This caulking cord is relatively inexpensive and easy to handle. It is applied with the fingers and cut with scissors.

An alternative to this type of caulking is the use of masking tape, either on the inside or outside of the window, for those windows that will not be operated during the heating season. Fabric-backed heating duct tape may be more suitable than masking tape, since it has less tendency to leave an adhesive on the window trim when it is removed.

Caulking compound is available in these basic types:

1. Oil or resin base caulk; readily available and will bond to most surfaces — wood, masonry and metal; not very durable but lowest in first cost for this type of application.
2. Latex, butyl or polyvinyl based caulk; all readily available and will bond to most surfaces, more durable, but more expensive than oil or resin based caulk.
3. Elastomeric caulks; most durable and most expensive; includes silicones, polysulfides and polyurethanes; the instructions provided on the labels should be followed.
4. Filler; includes oakum, caulking cotton, sponge rubber, and glass fiber types; used to fill extra wide cracks or as a backup for elastromeric caulks.

CAUTION: Lead base caulk is not recommended because it is toxic. Many states prohibit its use.

Estimating the number of cartridges of caulking compound required is difficult since the number needed will vary greatly with the size of cracks to be filled. Rough estimates are:

½ cartridge per window or door
4 cartridges for the foundation sill
2 cartridges for a two story chimney

If possible, it's best to start the job with a half-dozen cartridges and then purchase more as the job continues and you need them.

The seal between glass and its wood frame should be tight. Check out your glazing carefully and be certain that all the seals are intact without cracks or missing sections. If not they need repair. For this you should use putty or glazing compound, on the other hand, lasts longer and stays semi-soft and usable for a longer period of time. Both can be applied with a putty knife, after removing the old putty! Be sure to firmly press the compound into the crack for a good seal.

WEATHERSTRIPPING

There are essentially two types of weatherstripping: one which depends upon a mechanical interlocking of two parts, and the other which depends upon the compression of some resilent material between one or two moving surfaces.

Mechanical weatherstrips are most often used on doors. They consist of two parts, each being hook-shaped, one of which is installed on the door frame while the other is notched into the door edge. The second type mounts on the door stop, with the interlocking piece mounted on the door face. As the door closes, these hookshaped pieces interlock with a spring action, preventing air passage. A similar arrangement is often used on door bottoms, where one hook is part of a metal threshold and the other attached to the bottom of the door.

Another type of weatherstrip that uses both mechanical and compression action is used on the bottom of doors that must open over thick carpeting. In this case a compression-type weatherstrip is fastened to the bottom of the door at a point high enough to clear the rug, and it is lowered by mechanical action as the door approaches the threshold, forcing the felt, vinyl, or rubber strip down onto the threshold as the door reaches the closed postion.

The longest lasting weatherstrip is spring bronze. This comes in various shapes to fit almost every type of sliding or closing door but it is the most expensive and difficult material to install. Wind may also cause the strip to "hum" under certain conditions.

Where two surfaces must remain in close contact but still slide, the most popular type of weatherstrip is a wool or synthetic pile. This is the type used by most manufacturers for factory weatherstripping of windows. These synthetic piles wear well and remain springy for many years.

Probably the most popular type of weatherstrip used by do-it-yourselfers is foam plastic, either adhesive-backed or attached to a wooden strip. Foam rubber is somewhat more durable than plastic, but takes more force to compress and does not compress into as small a space as does foam plastic. If there are considerable variations in the space to be closed, foam plastic may be superior. A variation of this type of weatherstrip is vinyl or rubber tubing, sometimes foamfilled, which is compressed between two meeting surfaces.

The cheapest variety of compression weatherstrips is felt, but it has the least amount of resilience to accommodate variations in the gap to be filled. Also felt weatherstripping has little resistance to abrasion and is therefore used where two materials come together in compression rather than in a sliding fit.

Molded rubber or plastic strips are often used on door bottoms and thresholds. In the case of the threshold it is restrained at the edges with the center bulging up to meet the door. In the case of vertical operation, such as garage doors, the molded strip is nailed to the bottom of the garage door with the projecting edges coming down and conforming to the garage floor.

One very efficient weatherstrip for specialized application is the vinyl strip with enclosed magnets that snap the strip against a metal door. This is the type commonly used on refrigerator doors and is often standard equipment on metal-clad residential doors.

A fringe benefit that occurs with the application of tight-fitting weatherstrips on windows and doors is the reduction of outdoor dust and dirt that is blown into the house. Another fringe benefit is that street and traffic noise are reduced to some extent.

How To Weatherstrip

Any crack around a window or door that is loose enough for a dollar bill to be inserted and pulled out needs weatherstripping. You can weatherstrip your doors even if you're not an experienced handyman. There are several types of weatherstripping for doors, each with its own level of effectiveness, durability and degree of installation difficulty. Select among the options given the one you feel is best for you. **The installations are the same for the two sides and top of a door,** with a different, more durable one for the threshold.

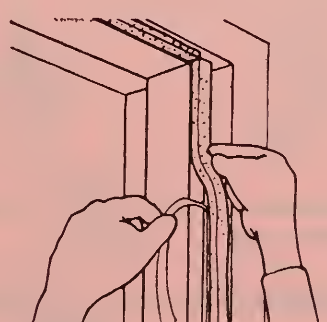
1. Adhesive backed foam:

Tools

Knife or shears,
Tape measure

Evaluation — extremely easy to install, invisible when installed, not very durable, more effective on doors than windows.

Installation — stick foam to inside face of jamb.



2. Rolled vinyl with aluminum channel backing:

Tools

Hammer, nails,
Tin snips
Tape measure

Evaluation — easy to install, visible when installed, durable.

Installation — nail strip snugly against door on the casing

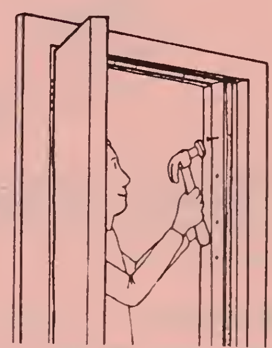
3. Foam rubber with wood backing:

Tools

Hammer, nails,
Hand saw,
Tape measure

Evaluation — easy to install, visible when installed, not very durable.

Installation — nail strip snugly against the closed door. Space nails 8 to 12 inches apart



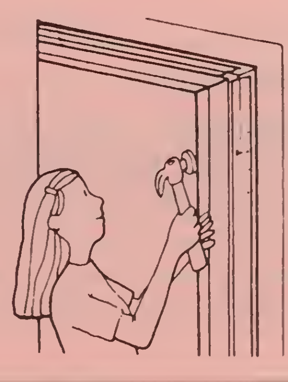
4. Spring metal:

Tools

Tin snips
Hammer, nails,
Tape measure

Evaluation — easy to install, invisible when installed, extremely durable.

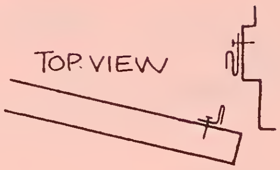
Installation — cut to length and tack in place. Lift outer edge of strip with screwdriver after tacking, for better seal.



Note: These methods are harder than 1 through 4.

5. Interlocking metal channels:

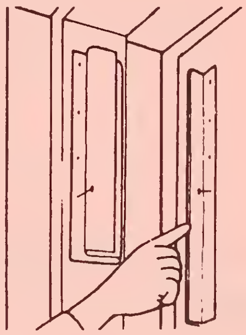
Tools



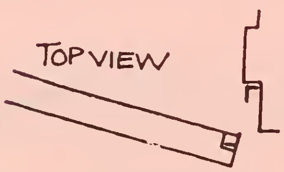
Hack saw,
Hammer, nails,
Tape measure

Evaluation — difficult to install (alignment is critical), visible when installed, durable but subject to damage, because they're exposed, excellent seal.

Installation — cut and fit strips to head of door first; male strip on door, female on head; then hinge side of door: male strip on jamb, female on door; finally lock side on door, female on jamb.



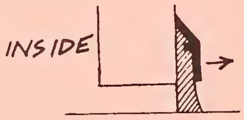
6. Fitted interlocking metal channels: [J-Strips]



Evaluation — very difficult to install, exceptionally good weather seal, invisible when installed, not exposed to possible damage.

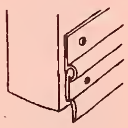
Installation — should be installed by a carpenter. Not appropriate for do-it-yourself installation unless done by an accomplished handyman.

7. Sweeps:



Tools

Screwdriver,
Hack saw,
Tape measure

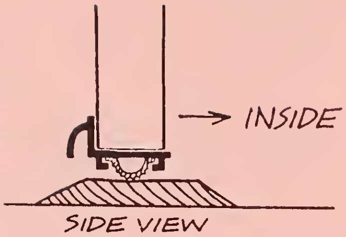


Evaluation — useful for flat threshholds, may drag on carpet or rug.

Installation — cut sweep to fit 1/16 inch in from the edges of the door. Some sweeps are installed on the inside and some outside. Check instructions for your particular type.

8. Door Shoes:

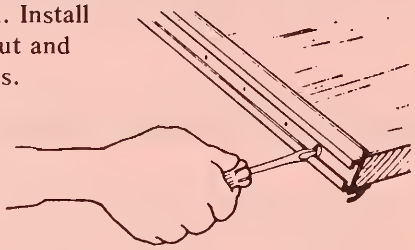
Tools



Screwdriver,
Hack saw,
Plane,
Tape measure

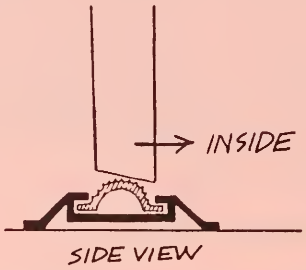
Evaluation — useful with wooden threshold that is not worn, very durable, difficult to install (must remove door).

Installation — remove door and trim required amount of bottom. Cut to door width. Install by sliding vinyl out and fasten with screws.



9. Vinyl bulb threshold:

Tools

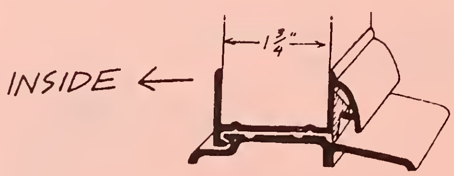


Screwdriver,
Hack saw,
Plane,
Tape measure

Evaluation — useful where there is no threshold or wooden one is worn out, difficult to install, vinyl will wear but replacements are available.

Installation — remove door and trim required amount off bottom. Bottom should have about 1/8" bevel to seal against vinyl. Be sure bevel is cut in right direction for opening.

10. Interlocking threshold:

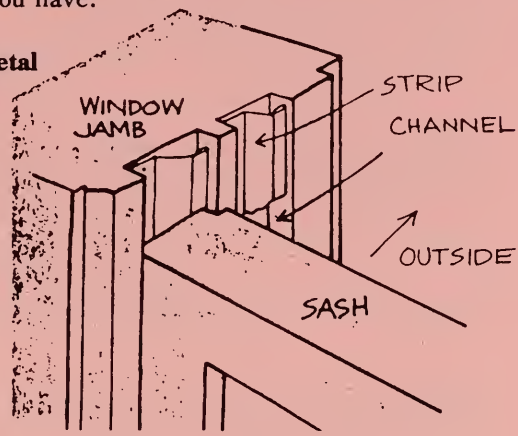


Evaluation — very difficult to install, exceptionally good weather seal.

Installation — should be installed by a skilled carpenter.

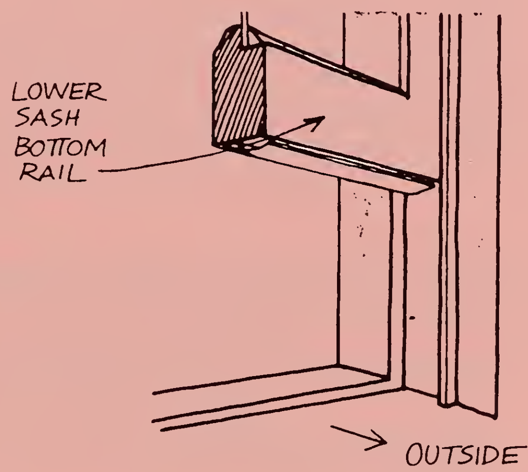
Weatherstripping is purchased either by the running foot or in kit form for each window. In either case you'll have to make a list of your windows, and measure them to find the total length of weatherstripping you'll need. Measure the total distance around the edges of the moving parts of each window type you have.

Thin spring metal



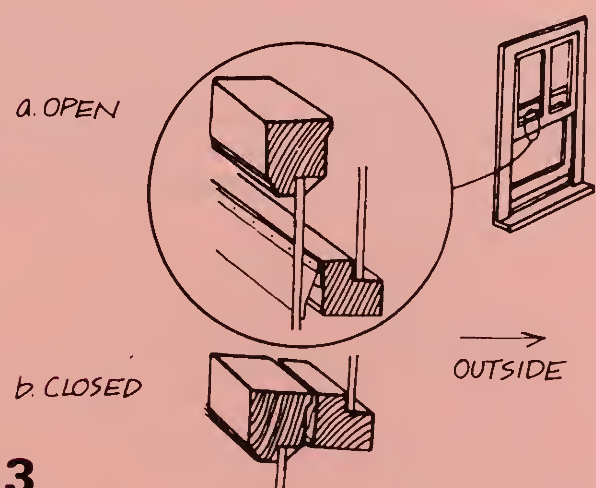
1

Install by moving sash to open position and sliding strip in between the sash and the channel. Tack in place into the casing. Do not cover the pulleys in the upper channels.



2

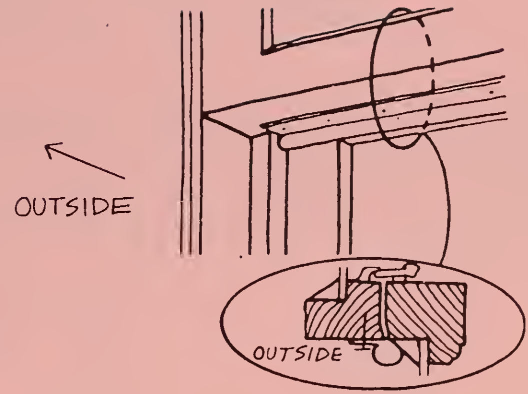
Install strips the full width of the sash on the bottom of the lower sash bottom rail and the top of the upper sash top rail.



3

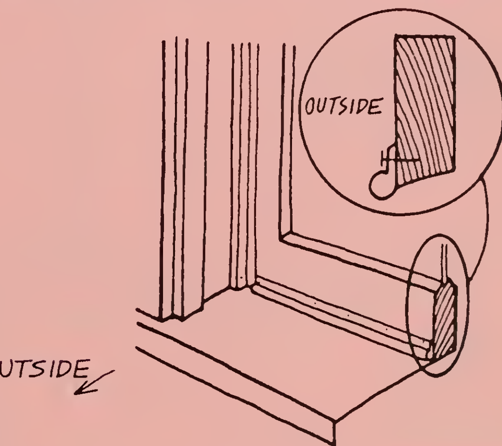
Then attach a strip the full width of the window to the upper sash bottom rail. Countersink the nails slightly so they won't catch on the lower sash top rail.

Rolled vinyl



1

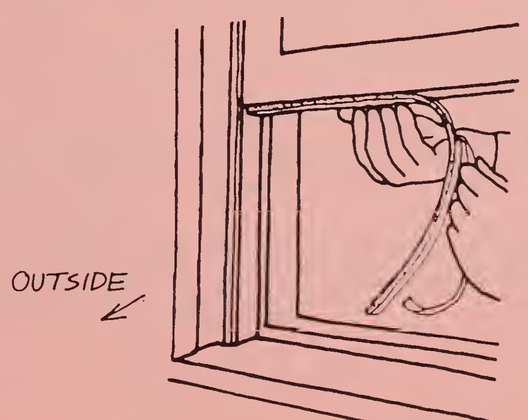
Nail on vinyl strips on double-hung windows as shown. A sliding window is much the same and can be treated as a double-hung window turned on its side. Casement and



2

tilting windows should be weatherstripped with the vinyl nailed to the window casing so that, as the window shuts, it compresses the roll.

Adhesive-backed foam strip



Install adhesive backed foam, on all types of windows, only where there is no friction. On double-hung windows, this is only on the bottom (as shown) and top rails. Other types of windows can use foam strips in many more places.

If storm windows are of the type that are completely separate from the prime window, weatherstripping is less important because there is enough of a double seal against outside air — once by the storm window and once by the prime window.

ENERGY CONSERVATION BULLETIN 1.5.1

Windows and Doors

Intermountain Rural Electirc Association 303 794 1535
2100 West Littleton Blvd. Littleton, Colo 80160

Windows and doors can be big energy-wasters. There are three reasons:

1) Glass itself is a highly heat conductive material. Similarly, many wooden doors are highly heat conductive.
2) Doors and windows that open necessarily have cracks all around them.
3) Air can pass through the joints around window and door frames if they aren't tightly sealed.

The last two problems can be overcome by installing weatherstripping and caulking. This paper deals with the first problem — the windows and doors themselves.

A single pane of glass has an R-value of about 1. So it loses about 12 times as much heat as the same area of properly insulated wall. Storm windows, or double glazing, will reduce the heat that is needlessly lost through the windows in your house by almost half! They will also make your house more comfortable by reducing drafts and increasing the temperature of the interior window, which would otherwise produce a "cold feeling."

Storm windows vary widely in design, durability, ease of use, and cost. They range from temporary plastic sheets to custom-made permanent installations.

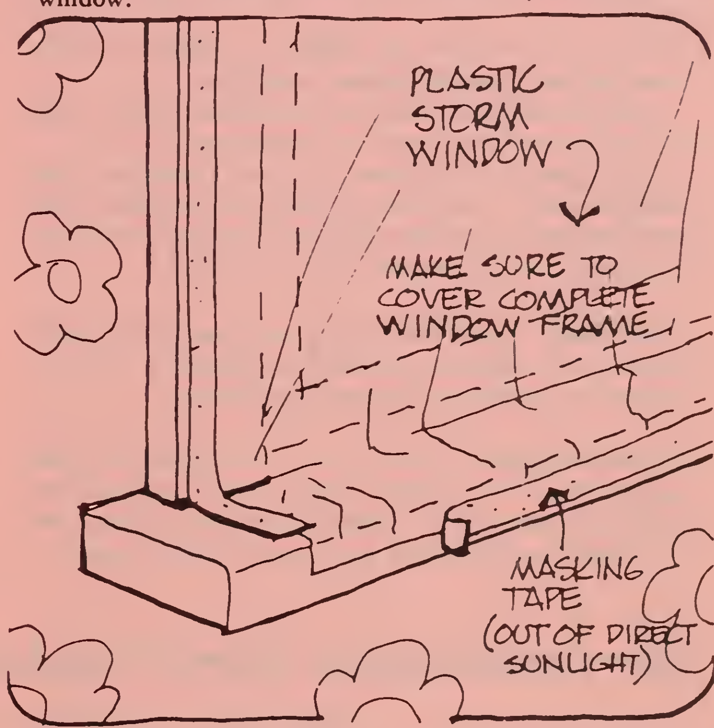
All are about equally effective. The more expensive ones are more attractive and convenient.

If you have any windows with just a single pane of glass, then you may choose one of four ways to upgrade them:

I—Plastic Storm Windows

Installation of plastic sheeting over the window is a very inexpensive and easy way to improve the heat retention of your home. The plastic will be less durable than glass, will have to be re-installed each year, and will reduce visibility from the window somewhat. Nevertheless, it is an effective "storm window."

Six mil polyethylene should be used. It should be installed inside the window since fewer moisture problems will arise, the plastic will be protected from the elements, and it is most easily installed this way. It should be attached to the main window frame so that it will block airflow that leaks around the moveable parts of the window.



A continuous strip of good quality masking tape around the entire frame is all that is needed to hold the plastic into place (cheaper brands of tape may lift the paint when eventually removed). Position the tape so that it is not exposed to the direct light of the sun.

Rigid, clear 1/8-inch acrylic plastic (Plexiglas, Lucite) sheets are available for as little as $1 a square foot, cut to size. If you edge it with narrow, adhesive-backed foam rubber strips, it can be placed over many kinds of windows with screws and without frames. It is especially handy for fixed windows. The plastic is more resistant to heat flow than glass.

This plastic should be protected from scratches and not washed with window cleaners containing ammonia; mild detergent is recommended.

II—Single Pane Storm Windows

Storm window suppliers will build single pane storm windows to your measurements that you then install yourself. Another method is to make your own with aluminum do-it-yourself materials available at most hardware stores.

Determine how you want thé windows to sit in the frame. Your measurements will be the outside measurements of the storm window. Be as accurate as possible, then allow 1/8'' along each edge for clearance. You'll be responsible for any errors in measurement, so do a good job.

When your windows are delivered, check the actual measurements carefully against your order.

Install the windows and fix in place with moveable clips so you can take them down every summer.

Single pane storm windows aren't as expensive as the double-track or triple-track combination windows. The major disadvantage of the single pane windows is that you can't open them easily after they're installed.

Frame finish: A mill finish (plain aluminum) will oxidize quickly and degrade appearance. Windows with an anodized or baked enamel finish look better.

Weatherstripping: The side of the aluminum frame which touches the window frame should have a permanently installed weather strip or gasket to seal the crack between the window and the single pane storm window frames.

III—Combination Storm Windows

Triple track, combination (windows and screen) storm windows are designed for installation over double hung windows. They are permanently installed and can be opened any time with a screen slid into place for ventilation.

Double-track combination units are also available and they cost less. Both kinds are sold almost everywhere, and can be bought with or without the cost of installation.

These permanent storms are more convenient than the removable type, but also more expensive. Make your decision accordingly. Regardless of which of the two types you choose, shop around a bit to make sure you get well made windows. Look at the quality of hardware used, quality of the weatherstripping, strength of joints, and so on. These windows are a long term investment. You may as well get the best.

You can save a few dollars (10% to 15% of the purchase price) by installing the windows yourself. But you'll need some tools: caulking gun, drill, and screw driver. In most cases it will be easier to have the supplier install your windows for you, although it will cost more.

The supplier will first measure all the windows where you want storm windows installed. It will take anywhere from several days to a few weeks to make up your order before the supplier returns to install them.

Installation should take less than one day, depending on how many windows are involved. Two very important items should be checked to make sure the installation is properly done.

Make sure that both the window sashes and screen sash move smoothly and seal tightly when closed after installation. Poor installation can cause misalignment.

Be sure there is a tightly caulked seal around the edge of the storm windows. Leaks can hurt the performance of storm windows a lot.

NOTE: **Most combination units will come with two or three ¼'' dia. holes [or other types of vents] drilled through the frame where it meets the window sill. This is to keep winter condensation from collecting on the sill and causing rot. Keep these holes clear, and drill them yourself if your combination units don't already have them.**

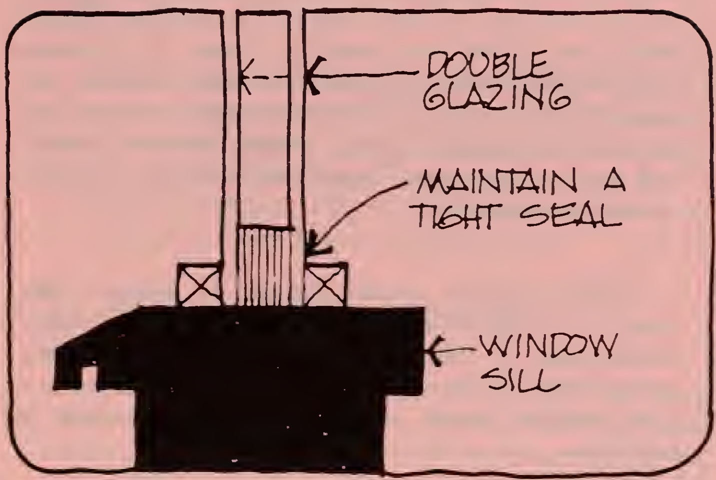
Frame finish: A mill finish (plain aluminum) will oxidize, reducing ease of operation and degrading appearance. An anodized or baked enamel finish is better.

Corner joints: Quality of construction affects the strength and performance of storm windows. Corners are a good place to check construction. They should be strong and air tight. Normally overlapped corner joints are better than mitered. If you can see through the joints, they will leak air.

Sash tracks and weatherstripping: Storm windows are supposed to reduce air leakage around windows. The depth of the metal grooves (sash tracks) at the sides of the window and the weatherstripping quality makes a big difference in how well storm windows can do this. Compare several types before deciding.

Hardware quality: The quality of locks and catches has direct effect on durability and is a good indicator of overall construction quality.

IV— Hermetically Sealed Double Glazing



This type of double glazing is simply a sealed unit of two panes of glass, approximately ¼ - ½'' apart, the gap being filled with absolutely dry air (or in some cases other gases). The seal around the glazing must remain perfectly air tight, since even the tiniest air leak will cause fogging inside the window.

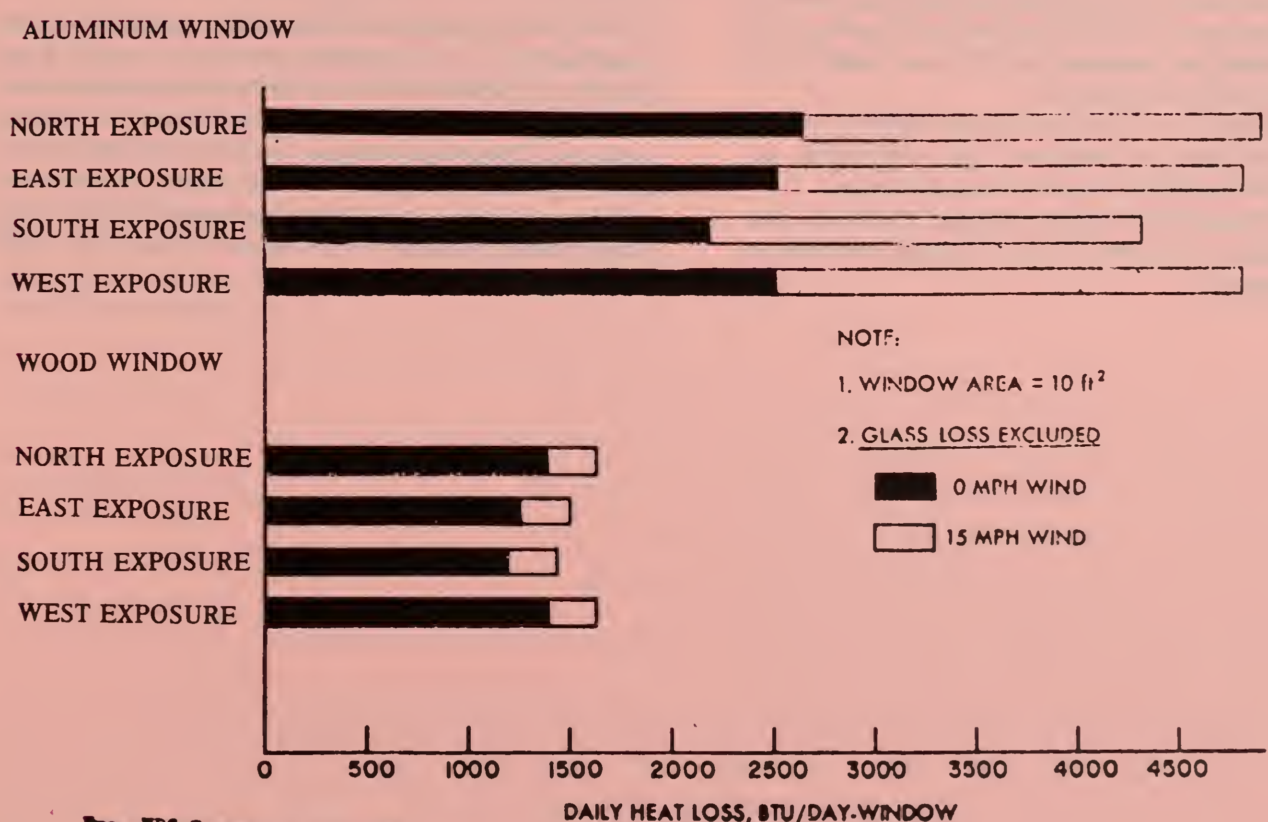
Since the cost of these windows is substantial, they are really only economical if you are planning to replace existing windows anyway.

V—Triple Glazing

In many colder parts of the world triple glazing is rapidly becoming more popular. It is more expensive but still may be worthwhile in most parts of Colorado. If you presently have only single glazing, adding a double glazed unit will decrease the heat lost through the windows by nearly two-thirds.

Similarly, if you presently have double glazing where the two panes of glass are close together (½'' or ¼'' apart), you may want to add a separate single storm window for further comfort. A system of triple glazing will usually pay for itself, in decreased fuel bills, within 15 years (and often less!).

WINTER DAILY HEAT LOSS FOR WINDOW FRAME



From NBS Technical Note 789

Solar Heat Gain

A window, unlike a wall, can transmit sunlight into a room, then trap its heat. In many instances, this solar heat gain can exceed the window's total conductive heat loss for the day. Thus, the window can actually provide heat in winter! To take fullest advantage of this, south exposures should have the greatest window area, followed by east and west exposures, and the window area on north exposures should be minimized.

Shading

Shading windows during the summer can eliminate the need for air conditioning during much of the cooling season and drastically reduce the load on the air conditioner when it is required.

Shading is most effective if it occurs outside the window. If a window is totally shaded and air can circulate between the shading device and the glass, solar heat gain can be reduced by 80 percent. Examples of effective external shading devices include canvas awnings, operable shutters (the louvered-type permits concurrent shading and ventilation), commercial "solar screens" (a series of closely spaced aluminum slats), and not to be forgotten — trees (deciduous species don't shade the winter sun). Shading can also be accomplished architecturally as with roof overhangs or trellises, if possible, designed to admit the winter sun, which is lower on the horizon than the summer sun.

Decorative insulations are materials applied to the interior of a house for the purpose of conserving heat as well as making the home more attractive. The hanging of draperies can save a great deal of energy. Heavy draperies drawn fully across a window can reduce the heat loss in the winter by 25 percent. If, however, the draperies also cover a heat outlet, such as a convector, diffuser, or radiator, they could increase the heat loss by channeling warm air against the window. To retain heat and save energy, the warm air should be introduced on the room side of the drapery, not on the window side.

Dome draperies are available with an insulated lining, either of the foam or reflective type, and these are somewhat more effective than conventional drapes.

A tightly fitting window shade, venetian blind, or inside shutter can also reduce the heat loss through a window by about 25 percent.

If inside shutters are used to cover windows during cold weather, the portion of the shutter that faces the window can be lined with a thin decorative foam plastic board, which may double the insulating value of a window equipped with insulating glass or a storm window. The paper-covered foam-core board is available at art supply and advertising display outlets. The board can be covered with fabric or be papered, painted, and so on for a pleasing exterior appearance.

Closing draperies, shades, blinds, or shutters does lower the temperature of the glass and it may cause condensation or frost formation if the humidity in the house is high. In fact, the presence of condensation is a good measure of the effectivenss of this method of insulation.

Decorative window coverings should, of course, be opened when the sun strikes the window in order to obtain the maximum solar heat gain. Draperies, shutters, blinds, and shades should be closed at night and during periods of overcast sky or high winds.

In the summer this treatment of decorative window insulation should be reversed. The window should be covered when the sun strikes it, and the draperies should be opened at night to allow as much heat as possible to radiate into the cooler night air.

With heavy draperies you are no longer exposed to cold window surfaces. Heat radiation from the body to the window surface is reduced.

With heavy full-length draperies, cold air currents that seep through the windows are slowed by the drapery near the floor. Cold air drafts are less noticeable across the ankles when draperies are closed.

Though many people believe that wood paneling adds significantly to the insulating value of a wall, if the paneling is substituted for conventional drywall products, it has no greater insulating value than the product replaced. If wood paneling in installed over an existing wall finish, it will help to a small extent. Quarter-inch wood paneling has an R-value of approximately 0.25. This is less than 2 percent of the desirable R-value of a well insulated wall.

Doors

The first and foremost item to check with doors are the cracks around the frame. A ¼" crack along the bottom can lose as much heat as a 3" x 3" hole in your living room wall — and you would surely repair that!

Assuming that you have a tightly fitting door, you have two options to make it more weatherproof:

I—Replace The Door:

Many doors today are made by using a softwood frame covered on both sides by thin plywood. Similarly, some older ornate doors have just a thin panel separating the warm from the cold in places. Such doors offer little resistance to heat transfer, and could profitably be replaced by a good, solid insulated door of at least 2 inch thickness. If your doors are standardized sizes, it should be fairly easy to obtain what you need from your building supplier. It should pay for itself within 5-10 years.

II—Add Storm Doors:

Though noticeably less effective in reducing heat loss than installing an insulated door, storm doors are valuable additions. Since most contain a combined window and screen arrangement, they can be sealed in winter but opened for ventilation in the summer.

You can save a few dollars (10% to 15% of the purchase price) by installing doors yourself. But you'll need some tools: hammer, drill, screw driver, and weatherstripping. In most cases, it will be easier to have the supplier install your doors himself.

The supplier will first measure all the doors where you want storm doors installed. It will take anywhere from several days to a few weeks to make up your order before the supplier returns to install them. Installation should take less than one-half day.

Before the installer leaves, be sure the doors operate smoothly and close tightly. Check for cracks around the jamb and make sure the seal is as air-tight as possible. Also, remove and replace the exchangeable panels (window and screen) to make sure they fit properly and with a weather tight seal.

Door finish: A mill finish (plain aluminum) will oxidize, reducing ease of operation and degrading appearance. An anodized or baked enamel finish is better.

Corner joints: Quality of construction affects the strength and effectiveness of storm doors. Corners are a good place to check construction. They should be strong and air tight. If you can see through the joints, they will leak air.

Weatherstripping: Storm doors are supposed to reduce air leakage around your doors. Weatherstripping quality makes a big difference in how well storm doors can do this. Compare several types before deciding.

Hardware quality: The quality of locks, hinges and catches should be evaluated since it can have a direct effect on durability and is a good indicator of overall construction quality.

Construction material: Storm doors of wood or steel can also be purchased within the same price range as the aluminum variety. They have the same quality differences and should be similarly evaluated. The choice between doors of similar quality but different material is primarily up to your own personal taste.

ENERGY CONSERVATION BULLETIN 1.6.1

Ventilation

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton Colo 80160

Attic Ventilation

It is important to close and seal tightly against air leakage from occupied spaces all openings into the attic. Keep outdoor air vents open in attics and crawl spaces in the winter time to prevent condensation of moisture in or on insulation or other building materials.

Due to the warmth and lighter weight of indoor air, as compared to that of the outdoor air in winter, there is a tendency for the air in the living space to flow upward into an attic if there are any openings through which it can do so. In the first place such flow represents a heat loss which may be considerable, in the second place, it conveys moisture from the occupied space into the attic where it might condense or deposit as frost which ultimately will melt and cause wetting.

Among openings through which such flow might occur are those around loosely fitting attic stairway doors, or pulldown stairways, penetrations of ceiling by electric light, or other fixtures, such as a ceiling fan used for summer cooling, or around plumbing vents or pipes, or air ducts which pass into the attic. In some cases the air spaces in interior partitions constitute paths by which indoor air can flow into the attic. In all cases, such openings should be sealed as tightly as possible to prevent upward air flow.

Ventilation above the insulation of the attic is necessary both winter and summer. In winter, the insulation keeps heat inside the living space below while the open vents let moisture vapor escape. In summer, the moving air lessens attic heat build-up.

Always provide at least two vent openings, located so that air can flow in one and out the other.

A combination of vents at the eaves and at the gable ends is better than gable vents alone. A combination of eaves vents and continuous ridge venting is best of all.

Here are the minimum amounts of attic vent area your home should have:

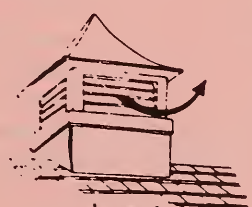
Combination of eaves vents and gable vents without a vapor barrier — 1 sq. ft. inlet and 1 sq. ft. outlet for each 600 sq. ft. of ceiling area, with at least half the vent area at the tops of the gables and the balance at the eaves.

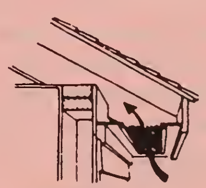
Gable vents only with a vapor barrier — 1 sq. ft. inlet and 1 sq. ft. outlet for each 600 sq. ft. of ceiling area.

Gable vents only without a vapor barrier — 1 sq. ft. inlet and 1 sq. ft. outlet for each 300 sq. ft. of ceiling area.

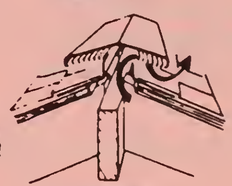
These recommended vent sizes are based on a completely open vent with no screen or louvers in front of it. Where vents are protected by screens or rain louvers, whether in attics or crawl spaces, the recommended size of the vent should be increased as follows:

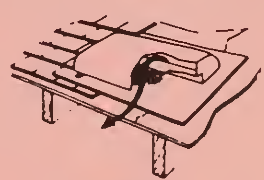
TYPE OF COVERING	SIZE OF OPENING
¼" hardware cloth	1 times net vent area
¼" hardware cloth and rain louvers	2 times net vent area
8-mesh screen	1¼ times net vent area
8-mest screen and rain louvers	2¼ times net vent area
16-mesh screen	2 times net vent area
16-mesh screen and rain louvers	3 times net vent area


cupola vent


eaves vent


gable vent


ridge vent


roof vent

Ventilation of an attic with outdoor air through the ventilating openings normally provided (total net area of openings equal to 1/300 of the attic floor area) is quite capable of expelling the moisture that might enter an attic from the occupied space if air leakage paths are moderately wellsealed. However, if leakage paths are excessive (that is, if the total area is greater than the attic floor area divided by 2,000) the capacity of the ventilating opening to remove moisture from the attic may be overtaxed at times of no wind. For this second important reason, leakage paths should be sealed as well as possible.

Crawl Space Ventilation

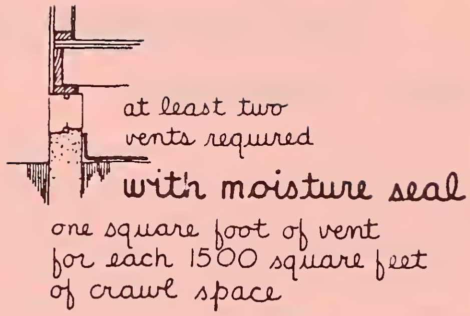
At least two vents, opposite each other, should be provided in an unheated crawl space.

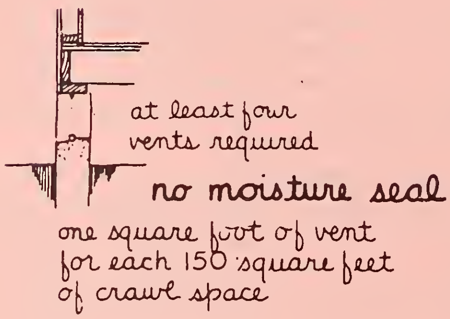
Basic minimum vent opening size, with moisture seal (4-mil-or-thicker polyethylene sheeting or 55-lb. asphalt roll roofing, lapped at least 3 inches) on the ground: 1 sq. ft. of vent for each 1,500 sq. ft. of crawl space area. Note that the addition of a ground moisture seal over the bare earth will markedly assist in keeping the crawl space humidity at a safe level.

Basic minimum vent opening size, without moisture seal: 1 sq. ft. for each 150 sq. ft. of area. Four vents, one of each of the four sides, are suggested.

If attic or crawl space vents are protected by screening or rain louvers, the basic opening size should be increased as shown in this table:

Type of Covering	**Size of Opening**
¼'' hardware cloth	1x net vent area
¼'' hardware cloth and rain louvers	2x net vent area
8-mesh screen	1¼ x net vent area
8-mesh screen and rain louvers	2¼ x net vent area
16-mesh screen	2 x net vent area
16-mesh screen and rain louvers	3 x net vent area





If your crawl space is properly insulated, you can leave vents in this area open in the winter. If you don't have insulation in your crawl space, you can close off some of the vent openings in the winter (don't close them all). Make sure they are open again in the spring.

ENERGY CONSERVATION BULLETIN 1.7.1
Ventilation/ Vapor Barriers

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd. Littleton Colo 80160

Moisture Control

The major problem that could be associated with any retrofitting program is that of moisture control. A retrofitting job done properly will not increase the likelihood of moisture problems. However, if proper insulation practices are not followed, some damage to the insulation and perhaps to the house might result. It is, therefore, important to have an understanding of the principles outlined here before proceeding.

Warm air holds more invisible water vapor than cold air. If war air is chilled by meeting cold air or a cold surface, part of the vapor in the warm air is condensed into water.

This is the reason for coasters under iced drinks and why the inside of windows fog up or get wet when outside temperatures fall sharply in humid climates.

When this happens within an outside wall or ceiling of a house, it is serious. The dampness can ruin insulation, and you know what trapped water can do to wooden beams, plaster and paint.

Instructions for installing insulation warn that the vapor barrier must be on the inside, toward the heat, but they seldom explain why. The barrier prevents the moisture-laden inside air from meeting cold air and condensing in the insulation or on the cold farther surface.

The first, and most important, step necessary to prevent this problem is humidity control.

Make sure the humidity in your house isn't too high. When this is coupled with the proper use of an air/vapour barrier and ventilation — both important parts of any retrofit program and of any house — no problems will arise.

Excessive interior humidity from household activities can be disposed of by kitchen,laundry and bathroom ventilating fans. Th[illegible] of these fans should be vented to the outside of the house, not into the attic, and the vents should be provided with an effective back draft damper. In the kitchen, range hood fans (vented to the outside) are the most efficient way to ventilate because they trap and exhaust heat, odor, moisture and smoke before they can circulate in the room. The Small Homes Council-Building Research Council recommends that hood fan capacity should be 100 cubic feet (3 cu m) per minute for each lineal foot (30 cm) of hood length. For example, a 3-foot (90 cm) hood would require a 300 cubic foot (8.5 cu m) per minute fan.

Recommended inside humidity for varying outside temperatures.

Outside Temperature (°C)	Recommended inside humidity at 20°C (68°F)
-30 or below	15%
-30 to -24	20%
-24 to -18	25%
-18 to -12	35%
-12 and above	40%

In any case, if on cold days heavy consensation develops on the inside of double glazed windows, the humidity is too high (unless, of course, the double glazed window is itself "leaky." If it is, cold air sneaking in will produce condensation regardless of humidity levels. Weatherstrip and caulk that window until it is tight). If the humidity is too high, disconnect any humidifiers, cover bare earth floors of cellars or crawl spaces with polyethylene film and so on. Get the humidity down.

Quantity of moisture added to the air by normal human activity:

Activity	lbs. of moisture
Washing clothes, per week	4.0
Drying clothes by hanging on a line indoors, per week	26.0
Cooking and dishwashing, per week	35.0
Each shower	.5
Each tub bath	.2
Normal respiration and skin evaporation per person per 24 hour day	2.9

Vapor Barrier 1.7.2

Vapor barriers, such as polyethylene, asphalt, glossy asphalt coated paper, laminated moisture-proof paper, foil-backed sheet rock, batts, or blankets should be used and applied near the warm surface between the inside finish and the insulation of all outside walls, outside ceilings, and the floors.

The measurement of water-vapor transmission of a barrier is expressed in perms. A perm, the unit of permeance, equals one grain (7000 grains = 1 pound) of moisture per square foot per hour per inch of mercury vapor pressure difference. For a vapor barrier to be effective it should be one perm or less. The part of the wall on the ouside of the barrier should have a permeance of at least 5 perms so that moisture vapor can escape easily to the outdoors.

When installing a vapor barrier, the number of joints should be held at a minimum. Every precaution must be taken so that the vapor barrier is not damaged during or after installation. If it is, it must be repaired completely and perfectly. Vapor pressure sealing tape is available to seal joints in the barrier and breaks around pipe and wiring outlet boxes.

When the outside wall is insulated but has no vapor barrier, or if the vapor barrier is installed on the cold side of the insulation, vapor penetrates the insulation and condenses inside the wall cavity causing rotting and decay. The condensation also wets the insulation, making it ineffective.

If polyethylene plastic film is used for vapor proofing walls, ceilings, or floors, it should have a minimum thickness of 0.002 inch. If the joints are not sealed, they should be lapped at least 2 inches on a stud or joist to obtain a pressure proof seal. Foil type vapor barriers come attached to some insulation blankets and batts and must be continuous for all wall sections.

When blown insulation is to be used in new work, continuous vapor barriers should be applied to the underside of ceiling joists where specified, and to the inside of wall studs. The barrier should be brought up tight against electrical outlets, registers, door and window frames, and other similar openings.

In an existing house where it is impossible to install a mechanical vapor barrier, paints may be used on the inside room surfaces. The following have proven effective: aluminum paint with spar varnish as a vehicle, some emulsion paints specifically designed for the purpose, primer sealer plus enamel, and rubber-resin lacquer types. Two or three coats are necessary.

A second vapor barrier should never be installed near the outside of the walls since it will result in moisture being trapped between the two vapor barriers. A porous wind-barrier type of paper should be used on the outside areas to provide an exit for entrapped moisture.

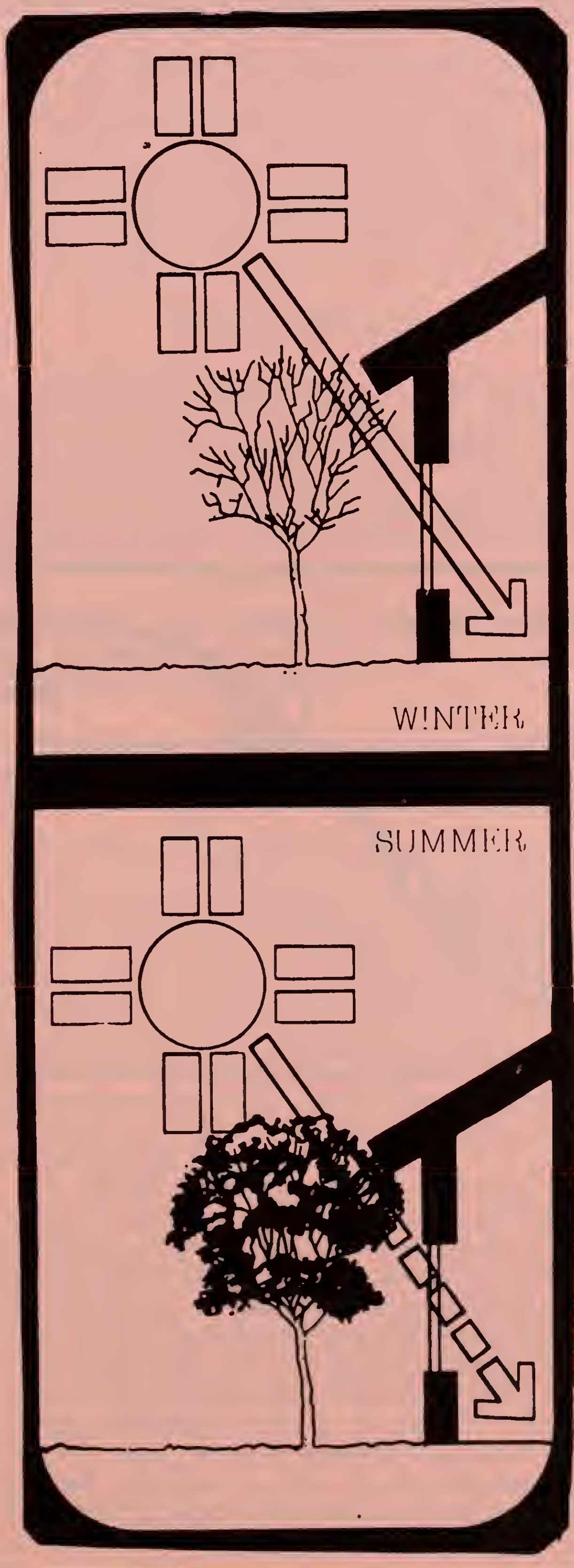
The vapor barrier for slab floors should be placed under the concrete. The water vaporpermeance of the material should not exceed 0.5 perm. For polyethylene a thickness of 0.004 inch should be used when placed on sand or tamped earth under concrete slab and 0.006 inch over gravel or crushed stone.

The ground surface of a crawl space should be graded and covered with a long life vapor barrier of either 55-pound asphalt-saturated felt roll roofing or 0.004 inch polyethylene plastic film. The roofing paper should be lapped 6 inches, and the plastic film joints should be lapped 2 inches or more, but neither should be sealed. The water vapor permeance of the ground cover material should not be more than 1 perm.

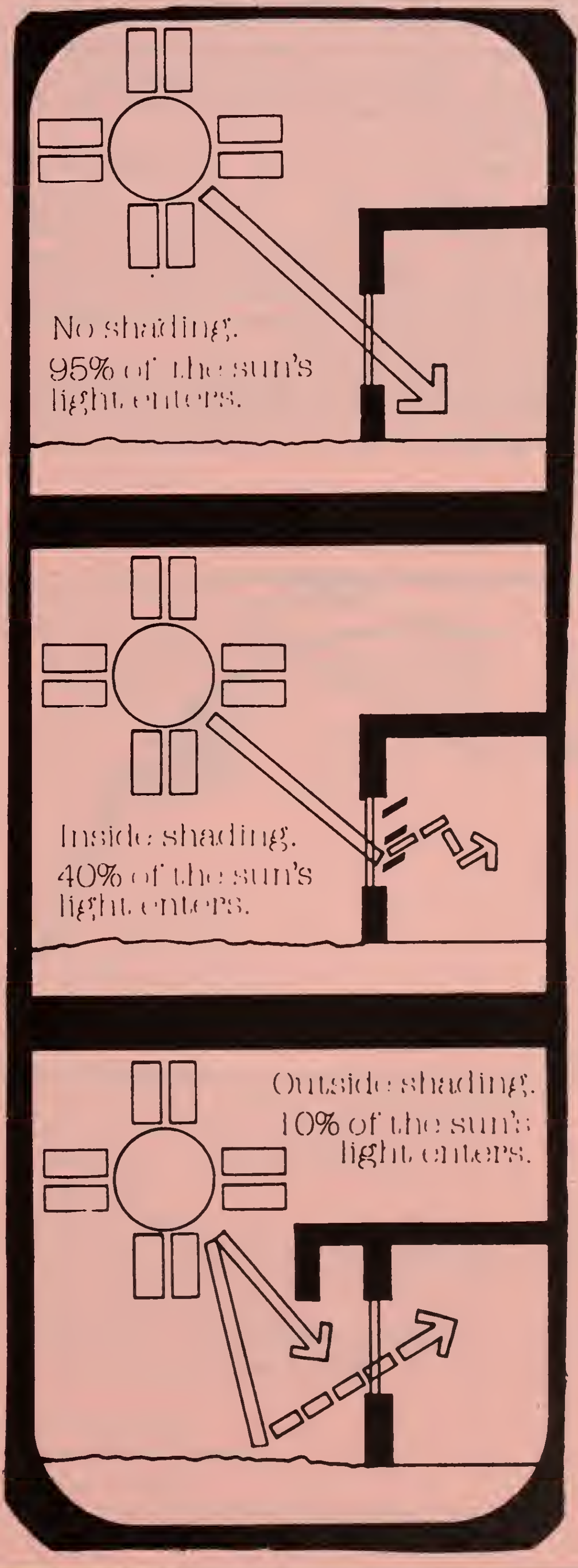
ENERGY CONSERVATION BULLETIN 1.10.1
Environmental Considerations

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Trees and shrubs around a house can help to protect it from the wind, which causes drafts and loss of heat. A single row windbreak is effective, but a staggered double row is better. Deciduous trees (those which lose their leaves in winter) near the house will allow the sun to help warm the house in the winter.



A good way to keep your house cool in the summer is to shade it from the outside. The South side is where the most heat comes through — if you can shade here, it'll show up right way in a smaller air conditioning bill and a cooler home. Any way that stops the sun before it gets in through the glass is seven times as good at keeping you



cool as blinds and curtains on the inside. So trees and vines that shade in the summer and lose their leaves for the winter are what you want — they'll let the sun back in for the winter months. If you can't shade your house with trees, concentrate on keeping the sun out of your windows — awnings or even permenent sunshades will do the job (but only on the **south** side; they won't work on the east and west).

Roof overhangs shade houses from the summer sun without shading the winter sun when designed properly. This is due to the higher maximum altitude of the summer sun as compared to the winter sun.

Thick evergreens on the north and northwest side shield the house from the prevailing winter winds and they can aid cooling in summer. Forest service researchers note that transpiration from a single tree may produce 600,000 Btu/day of cooling.

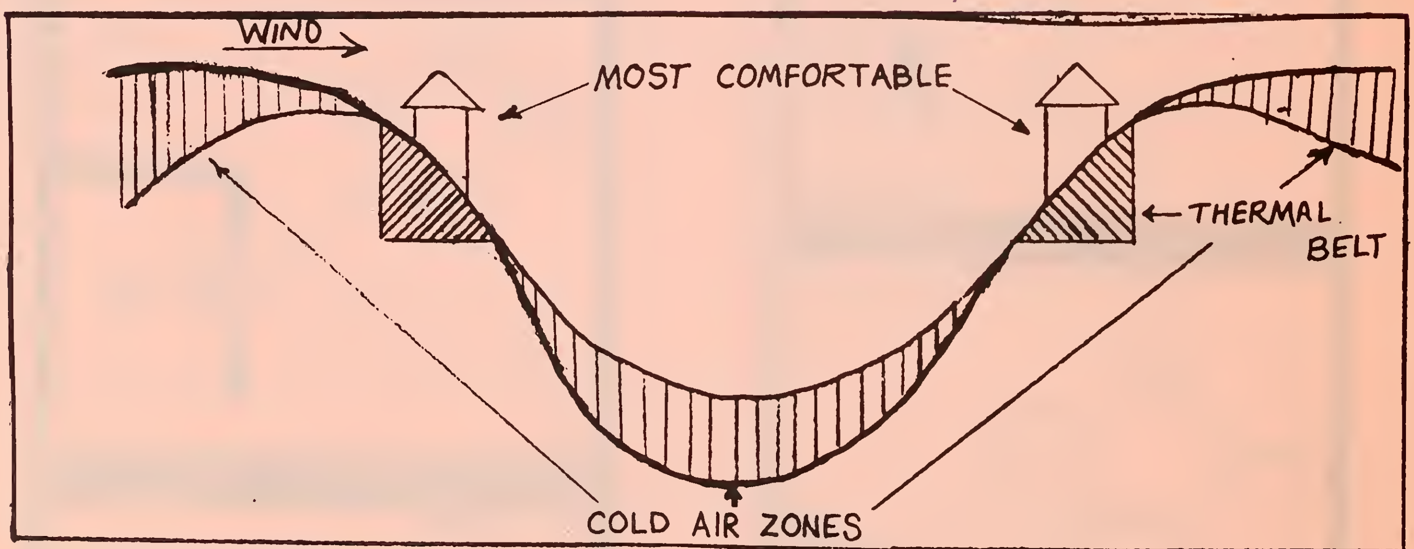
In most parts of the country air conditioning is not necessary. Insulation, shade and natural ventilation sometimes supplemented by an attic exhaust fan are quite adequate if properly used. If shade trees are not yet large enough to provide adequate shading, various commercial products such as adjustable louvers and tinted plastic are available to cut down heat gain.

The placement of houses in hilly or mountainous regions is an important environmental consideration. The diagram illustrates positions which will have the greatest thermal comfort.

The valley is coldest at night and has earliest frosts. Also, it is often the hottest on hot summer days because sunlight is reflected off the hillside. Strong winter winds may also blow through the center of the valley and be unfelt on the hills. But be sure your site has adequate direct sunlight.

Windows should be avoided or kept to a minimum on the north side as their main effect is heat loss in winter.

Large paved areas near the house can reflect heat into the house and cause excess heating in summer.



ENERGY CONSERVATION BULLETIN 2.1.1
Electric Heating Systems

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton Colo 80160

ELECTRICITY is energy in a refined form which is ideally suited to space heating because it is simple to distribute and control. For many applications, the compactness, simplicity, responsiveness, accuracy of control, safety, and cleanliness of electric heating may outweigh other considerations in choice of heating method. The adaptability of electric energy for distribution, conversion, and regulation within a structure, as compared with fossil-type forms of energy, provides a most effective and efficient means of utilization of energy for space heating. Complete electric heating systems are widely used in residences, schools, and in many commercial and industrial establishments. Electric space heating is often used where minimum initial cost is the dominating factor. Electric heating systems may be used to supplement solar heating systems.

DECENTRALIZED SYSTEMS

Decentralized systems utilize units applied to individual rooms, and while usually only one type predominates per room, types may be mixed if occasion arises. Often the individual rooms are combined into a system or zone. Examples of equipment so utilized are electric baseboard heaters, convectors, sill-line heaters, unit heaters, and unit ventilators.

CENTRALIZED SYSTEMS

Central Hot Water Systems

Heating systems of hot water type using radiators or convectors, may be operated using an electric hot water boiler containing immersion elements. Such boilers are extremely compact and may be designed for wall mounting. The size of a 20 kw boiler is about 1.5 cu. ft. Multiple elements of appropriate kw capacity (from 2 to 5 kw each) make up the total heating capacity required. The elements are usually arranged to be energized or de-energized in sequence to avoid large voltage disturbances. The elements should be interlocked to prevent energizing when the circulating pump is not operating. Some makes of boilers are particularly adaptable to multiple zoning by having control systems which energize the number of elements that match the heating needs of the zones calling for heat.

For off-peak operation, a water heating tank of large storage capacity may be employed. The system may be designed for a water temperature of 250 to 275 F at pressures up to 75 psig, with suitable piping systems for this pressure. An automatic valve may provide 140 to 160 F water at the pump by mixing hot water from the tank with cooler water from the return main. Another method employs the flash principle, withdrawing water at high storage temperature into a low-pressure separating chamber where steam is obtained as a result of the pressure reduction; however, power for pumping is substantially greater with this steam-accumulator method.

Central Warm Air Systems

Central blower and air duct systems are adaptable when summer cooling is planned or when circulation, filtering, humidifying, or dehumidifying of the air is desired. Such systems furnish a convenient means for positive intake of fresh air.

Compact electric heating units are sometimes installed in main supply or branch ducts of central-fan steam and water systems to provide the final temperatures and relative humidities required for comfort or process air conditioning. Electric heaters installed for use primarily in the heating cycle can also be utilized for reheat in the cooling cycle.

Individual room control is obtained by using electric duct or air outlet heaters.

Electric furnaces, consisting of resistance heating coils and a blower housed in an insulated cabinet, are available in sizes ranging from 5 kw to 60 kw for use with residential ducted warm air systems. Electric furnaces are compact, require minimum wiring and no fuel connections or fuel piping. While not adaptable to individual room control, a separate electric furnace may be used for each of two or more larger zones.

Principal Types of Electric Space Heating Systems

Decentralized Systems

A. Natural Convection Units
   1. Floor drop-in heaters
   2. Wall insert and surface mounted heaters
   3. Baseboard convectors
   4. Hydronic baseboard convectors with immersion elements

B. Forced Air Units
   1. Unit ventilators
   2. Unit heaters
   3. Wall insert heaters
   4. Baseboard heaters
   5. Wall insert heaters
   6. Floor drop-in heaters

C. Radiant Units (high intensity)
   1. Radiant wall, insert or surface mounted; open ribbon or wire element
   2. Metal-sheathed element with focusing reflector
   3. Quartz tube element with focusing reflector
   4. Quartz lamp with focusing reflector
   5. Heat lamps
   6. Valance heaters

D. Radiant Panel-Type Systems (low intensity)
   1. Radiant ceiling with embedded conductors
   2. Pre-fabricated panels
   3. Radiant floor with embedded conductors
   4. Radiant-convector panel heaters

Centralized Systems

A. Heated Water Systems
   1. Electric boiler
   2. Electric boiler, with hydronic off-peak storage

3. Heat pumps
4. Integrated heat recovery systems

B. Steam Systems
1. Electric boiler, immersion element or electrode type

C. Heated Air systems
1. Duct heaters
2. Electric furnaces
3. Heat pumps
4. Integrated heat recovery systems
5. Unit ventilators
6. Self-contained heating and cooling units

The above units have commercial-industrial as well as residential applications. The more common residential decentralized units include the radiant panel-type systems (low intensity) and the natural convection units, particularly the baseboard convectors and the hydronic baseboard convectors with immersion elements.

Intermountain Rural Electrical Association generally recommends these separately controlled (decentralized) heating systems. They are typically cheaper to operate and less of a burden on the overall electrical systems than the centralized units.

Since decentralized units have individual thermostats in each room, energy can be conserved by lowering or shutting them of in areas where heat isn't needed. Decentralized units are also very compatible with load control devices.

FURTHER CONSIDERATIONS

Any electric heating unit considered for purchase and installation should bear the Underwriters Laboratories Listing Mark, giving the purchaser assurance that it has been tested, and is listed by Underwriters Laboratories (or has the CSA mark, in Canada).

Separately-controlled units [Decentralized System]

Baseboard radiation. These units are similar in outward appearance to the baseboard radiation commonly used with gas-and oil-fired hot-water heating systems. As they provide heat mainly by convection, they may cause problems of dirt — streaking on the walls. They are, on the whole, a very satisfactory means for heating a room by electricity.

Buit-in wall heaters supply heat mainly by radiation. Some models are equipped with small fans which increase slightly the amount of heat given off by convection. The fan produces a slight amount of noise.

Resistance wires embedded in the ceiling in ceiling panels, and ceiling heaters controlled by wall-mounted thermostats are sometimes used for electric heating. The embedded wires have the disadvantage that there is a considerable lag between the time heat is called for and the time when a room becomes noticeably warmer. Heat from the ceiling is supplied mainly by radiation. Portable space heaters are designed to give rapid, deep-room penetration. Portable electric heaters can be moved from one spot to another. Various models feature: fixed or portable heavy-duty thermostatic controls with a range of 55° to 100° F; automatic current cutoff if heater is tipped forward or the front is obstructed; and dual-wall construction to keep the cabinet cool and safe to the touch. This type heater should be used only for temporary or emergency applications.

Central systems

A central heating system using electricty functions in much the same way as a system using oil, gas, or coal as a fuel. The heat is produced at one location and distributed throughout a home.

In a forced-air electric furnace, air is heated as a blower forces it past heated resistance elements and into a system of ducts. Such a system heats rooms by convection and offers air filtering and relatively easy adaptation to air conditioning as two important advantages. Electric forced-warm-air heat does, however, present most of the disadvantages related to the need for space for the furnace and existence of blower noise that are characteristic of gas or oil forced-air heating.

Electric hydronic (hot water) systems employ conventional baseboard radiation by which heat is transferred from the radiators, by both radiation and convection. Electric hydronic systems are characterized by a very small boiler, and they offer the decided advantage that they do not require any provision for entrance of some cold outdoor air into the house (or furnace room), as is necessary for safe combustion of gas, oil, or coal fuels.

A heat pump can function as a heating OR cooling source. As the name implies it produces heat by using the compressor as a pump. Electricity is not converted directly into heat as occurs with other kinds of electric heating. In the cold seasons, a heat pump extracts heat from the cold outside air, and carries it into the house. (Actually outdoor air, though cool, contains recoverable heat). Instead of supplying about 3400 Btu for every kilowatt-hour expended (the usual Btu per kwhr conversion ratio), a heat pump will supply 1¼ to 2 times that amount, depending upon the temperature outdoors. Thus it supplies a means of heating with electricty at about two thirds the usual cost (neglecting investment costs, depreciation, and maintenance of the equipment). In the warmer months, the flow of the refrigerant in the machine is reversed — the heat pump then functions to remove heat from the building and thus functions as an air conditioner.

There are several important points to consider with regard to use of a heat pump:

1) The machine and its installations will likely be expensive.

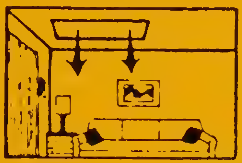
2) In the wintertime, efficiency falls off to a low figure as outdoor temperatures fall. As temperatures drop well below about 40°F outdoor, the heat pump needs more and more support and regular resistance-type heaters — which are much more costly to run — are turned on, automatically as a rule.

ENERGY CONSERVATION BULLETIN 2.2.1
Electric Heating : Radiant

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Comfort, as defined by ASHRAE Standard 55-74, is "that condition of mind which expresses satisfaction with the thermal environment." The person is not aware that he is being heated or cooled. Recent investigations have broadened our knowledge regarding the human body and its response to the surrounding environment. The mean radiant temperature (MRT) has a strong influence on the feeling of comfort. When the surface temperature of the outside walls, particularly those with large amounts of glass, begins to deviate excessively from the ambient air temperature of the space, it becomes increasingly difficult for convective systems to counteract the discomfort resulting from cold or hot walls. Heating and cooling panels neutralize these deficiencies and minimize excessive radiation losses from the body.

Radiant Ceiling Panels



Panel heating systems function on the basis of providing a comfortable environment by means of controlling surface temperatures and minimizing excessive air motion within the space.

Radiant heat comes from thread-thin wire embedded in panels, which are flush with or suspended from ceiling.

- •Whole house or supplemental heating.
- •Especially good over large glass areas.
- •Individual room control.
- •Easily installed in new or existing home.

The ceiling is the room surface most often used for location of the radiant panel. It sees all other surfaces and objects in the room. It is not subject to unpredictable coverings, as are floors. Higher surface temperatures can be used. It is of smaller mass and therefore has quicker response to load changes. Radiant cooling can be incorporated, and, in the case of the metal ceiling system, the piping is accessible if in need of service.

Radiant panels are unique in that, unlike most heat transfer equipment where performance can be measured in specific terms, the performance of the radiant panel is related directly to the structure in which it is located, and an understanding and evaluation of this interrelationship is desirable.

SIZES AND INSTALLATION

Easily installed, either flush with ceiling or protruding slightly, in all types of new or remodeled construction. Panels are usually rectangular. Most are pre-wired and assembled by the manufacturers.

SUGGESTED APPLICATION

Whole-building and supplemental heating. Panels are especially useful over large glass areas. Used in bathrooms, kitchens, family, and recreation rooms as well as problem heating areas.

Radiant Cable Heat

Gentle, even heat radiates from cable embedded in ceilings (or floors).

- •Completely out-of-sight.
- •Individual room control.
- •Silent operation.
- •No maintenance.

Ceiling cable is hidden, so it puts no limits on furniture arrangement. It beams soft heat into the room over a wide area, so people are usually unaware of the heat source. And it can move, stretch, or bend with any movement of the ceiling or house.

Ceiling cable, though least expensive to install, demands heavier ceiling insulation than wall panels and baseboard units. Otherwise, you'll lose too much heat to the attic, and operating costs will rise.

ENERGY CONSERVATION BULLETIN 2.3.1

Electric Heating : Resistance Units

Intermountain Rural Electric Association 303 794-1535
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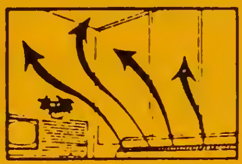


Baseboard

A metal casing, in the same configurations as conventional baseboard along walls, contains one or more heating elements placed horizontally. Heating elements may be finned sheathed, cast grid, ceramic extended surface, or electrically conductive coatings on glass or other material. The vertical dimension is usually less than 9 in., and projection from wall surface is less than 3.5 in. Units are available from 1 to 12 ft. long with ratings from 100 to 400 watts per ft of length and are designed to be fitted together to make up any desired continous length or rating. Sill heaters are available with ratings up to 1000 watts per ft. Electric hydronic baseboard heaters containing immersion heating elements and an antifreeze solution are available in ratings from 300 to 2000 watts. Air circulates from a slit at the bottom, over the heating element and out into the room. There is no noise from moving air or equipment, blowers, or parts.

INSTALLATION

They should be placed at floor level of outside wall. Heat circulation is not distributed by furniture placement.

Baseboard units are usually self-contained. Installation is fast and easy since most types are pre-wired and assembled at the factory.

This electric resistance heating is strung together like continous toasters along outside walls. They usually take 240-volt current.

- Compatible with existing baseboard.
- Easily and quickly installed in new or existing homes.
- Individual room control
- This system produces no fumes, gas or smoke, is quiet and requires very little maintenance.

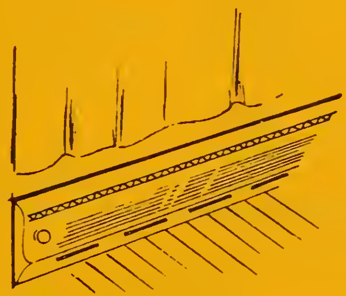
Baseboard units help keep wiring out of the walls, thus reduce high wiring costs. Most baseboards have plenty of room for lighting and appliance circuits. Receptables, available in most baseboard lines, can be fitted right into the ends of the units.

High-temperature baseboards offer the most efficient electric heat in colder climates. They put the heat where it's needed most — around the perimeter of the house. Low-temperature baseboards offer "softer," less concentrated heat.

Baseboard units save labor because they are surfacemounted after the wall is finished. All you do before finishing the wall is to install the 240-volt leads (some low-temperature units take 110).

Baseboard comes in sections that vary in length from 2' to 12' and in height from 6" to 10". It has corner pieces and can be painted.

NOTE: Drapes should be shortened, so as not to come in contact with heaters.



Wall Heater [picture]

If it doesn't interfere with window treatment, unit should be placed on outside wall. Due to high temperature, unit should not be located close to inside doors or furniture.

- Individual room control.
- May be installed where heat is required only occasionally.

In many wall and floor insert heaters, a small fan circulates room air over the resistance heating elements and back into the room. They are all regulated by thermostatic controls (either built-in or wall-mounted). Installation of a complete unit into a roughed-in box takes only a few seconds since the reflector heating elements and controls may be mounted to the grille front.

Wall units are recessed into the wall (and sometimes the ceiling) so that only the front of the units projects into the room. So it is necessary to build in frame boxes, like rough window openings, at the framing stage of construction. This means extra labor and higher installation costs.

You can keep costs down by using wall panels where you want to concentrate heat (ie, in bathrooms) and baseboard units in other rooms.

ENERGY CONSERVATION BULLETIN 2.4.1

Hot Water Heaters

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Buying A Hot Water Heater

When purchasing a water heater, match its size to the needs of your family. Oversized water heaters use more energy than necessary.

Cost of Operation

A. Approximately 17% of the total-electric bill of an all-electric home goes to water heating.
B. About 47% of the total-electric bill for the all-electric home without electric heat is for the electric water heater.
Energy-efficient water heaters may cost a little more initially, but reduced operating costs over a period of time can more than make up for the higher outlay.

•Buy a water heater with thick insulation on the shell. While the initial cost may be more than one without this conservation feature, the savings in energy costs over the years will more than repay you.

•Add insulation around the water heater you now have if it's inadequately insulated, but be sure not to block off needed air vents. That would create a safety hazard, especially with oil and gas water heaters.

*Heating of water continues even if hot water is not being used.
Standby heat loss varies on water heaters depending on the location, the size of the heater and the amount of insulation used.

Average standby losses vary from 4 watts per sq. ft. to 7.9 watts per sq. ft., depending on the thickness of insulation used.
Square feet of tank area averages about —
26 sq. ft. for a 50-gallon heater
30 sq. ft. for a 66-gallon heater
36 sq. ft. for a 80-gallon heater

INSTALLING A HOT WATER HEATER

*Place the water heater as close as possible to where hot water is used. Long runs of pipe cool hot water, thus increasing operating costs.

*If you do have long pipe runs, insulate the pipes to decrease heat loss. This also conserves water which may be wasted by letting it run until it gets hot.

OPERATING A HOT WATER HEATER

- Check the temperature on your water heater. Most water heaters are set for 140°F. or higher, but you may not need water that hot unless you have a dishwasher. A setting of 120 degrees can provide adequate hot water for most families.

If you are uncertain about the tank water temperature, draw some water from the heater through the faucet near the bottom and test it with a thermometer.

In the average home between 35% and 50% of total water use is hot water.

ESTIMATED WATER USE

A. Tub bath	10-15 gal.
B. Shower (under 5 min. duration)	8-12 gal.
C. Automatic washer	25-30 gal.
D. Automatic dishwasher	11-16 gal.
E. Hand wash dishes (each time)	9-14 gal.
F. Shampoo	5-7 gal.
G. Cleaning	3-8 gal.
H. Food preparation	5 gal.

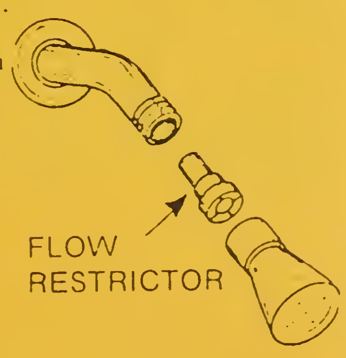
AVERAGE HOT WATER USED PER DAY

2 adults 1 child — 60 gal.
2 adults 2 children — 70 gal.
2 adults — 3 children — 80 gal.

A leaking hot water faucet should never be disregarded. Little drops of water cost money. Here are several typical examples of how much hot water and electricity can "go down the drain" through leaky faucets!

DROPS PER MINUTE	GALLONS PER MONTH	KWH PER MONTH
60	192	48
90	310	78
120	429	107

To reduce consumption a "flow restrictor" to limit the shower flow may be helpful. This little device can be installed in minutes, and can cut the shower flow from 6 gpm to 3 gpm, thus saving a lot of hot water and reducing energy requirements for heating water.



*Approximately three times a year, drain a pail or two of water from the faucet at the bottom of your hot water tank to get rid of sediment and mineral deposits. This will lengthen the life of the unit and assure a higher operating efficiency.

*When you go away for a period of time — for a weekend or longer, vacation, etc., shut the electricity off to the hot water heater.

ENERGY CONSERVATION BULLETIN 2.5.1
Thermostatic Controls

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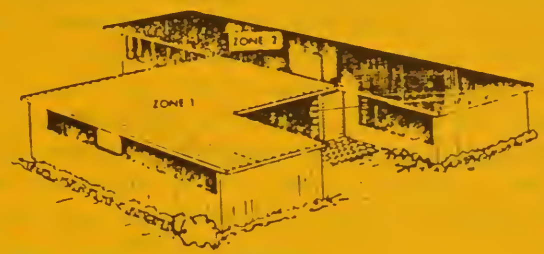
Automatic controls are designed to run heating and cooling systems automatically so that they function only when heating or cooling is needed. This helps keep the house at an even temperature, which adds to the comfort of the occupants and reduces the cost of operating the system.

The heart of the control system is the thermostat, essentially a temperature-sensitive switch that turns the heating system (or cooling system) on and off. Some thermostats are designed so that various stages or parts of the heating system can be turned on or off so that the heat input is "modulated" to match the heat loss of the house. Many thermostats are equipped with small heating elements called anticipators. The anticipator raises the temperature within the thermostat case, giving it a false reading and causing it to turn the system off before the room reaches the desired temperature. The residual heat in the system will then bring the temperature up to the desired point. If there is not sufficient residual heat, the thermostat will sense the deficiency and turn the system on again. In this way the desired temperature is reached in small steps so that the house is not overheated, with a resultant waste of fuel and occupant discomfort.

In many instances, one thermostat is used to control the temperature in several rooms or the whole house. Actually, it can sense the temperature only in the room where it is located. For this reason it is importa-t that the thermostat be located either where the ter rature is representative of the whole house or where temperature control is most important. Locate the thermostat at a height of 2½ to 4 feet above the floor. Avoid locations on ouside walls, near outside doors, or in bedrooms where windows may be left open. Likewise, do not place it near heat outlets, behind doors, on walls that receive heat from the sun or fireplace, or on walls that house heating pipes ducts, or chimneys. Avoid locations that may interfere with furniture placement. Lamps, TV sets, or radios under a thermostat will give it false readings and result in poor control of the heating system.

In some cases, it may be desirable to divide the house into 2 or more zones for heating (or cooling) control. With non-central systems (such as electric resistance baseboard or ceiling cable), zone control is relatively easy to achieve.



With ducted or piped systems, the distribution lines must be specifically designed for this purpose. Zoning is used to help maintain the same temperature in various parts or levels of the house. Zoning should be considered for multi-level or large houses, or when there are unusual sun or wind exposures.

The division into zones should be based upon exposure or occupancy; the most common division is usually found to be: (1) the living section such as living room, dining room, den; (2) the sleeping section; (3) the service section such as kitchen, pantry and (4) recreational areas.

The thermostat should be set at the point at which the occupants are most comfortable and left at that setting except for special circumstances. These special times occur at very cold outside temperatures, when heating is almost continuous. At that time, thermostats equipped with anticipators may have a tendency to "droop" and maintain a temperature a few degrees below the setting. In these cases, the thermostat setting will have to be adjusted. A setting above the desired temperature will not make the temperature rise any faster nor will a low setting cause the house to cool any faster. The speed with which the temperature in a house will respond to a change in the thermostat setting will depend on the type of heating system and the construction of the house.

If you leave home for a few days turning your thermostat down can result in savings. However, never turn your thermostat completely off. A sudden cold snap could cause your pipes to freeze and burst causing substantial damage to your home.

Maintenance. A properly functioning thermostat will keep your home at comfortable temperatures. However, a number of things can affect its performance. The most common problem causing poor thermostat operation is dust covering the sensing element or contact points. A layer of dust will reduce the speed with which the thermostat feels a change in temperature, which allows the house to get too cold before the heating system comes on and lets it get too hot before it shuts the system off. To correct this problem, remove the cover from the thermostat and carefully vacuum the mechanisms. If the material is caked on, a service call will be required.

Another occasional problem is that the thermostat loses its calibration. For example: The thermostat is set on 68° and the room temperature is more than 2° or 3° above or below this (72 or 64°). The easiest solution is to set the thermostat at whatever position it takes to maintain the desired room temperature and mark this point. Some models have a calibration adjusting screw on the sensing coil mounting. Others require repositioning the thermostat on the wall so that it is level. To recalibrate a thermostat, use a good quality thermometer to measure the temperature near the themostat. Then move the sensing element so that the contacts just open when the pointer is set at the room temperature. Some readjustment may be needed if an accuracy of 1° or less is desired.

A third way that the thermostat can fail is by a break in the anticipator. This may cause some overheating of the room before the furnace shuts off. If the variation between "on" and "off" is not too great, you can set the thermostat to a lower setting. Repair of the anticipator requires a good serviceman or replacement of the thermostat.

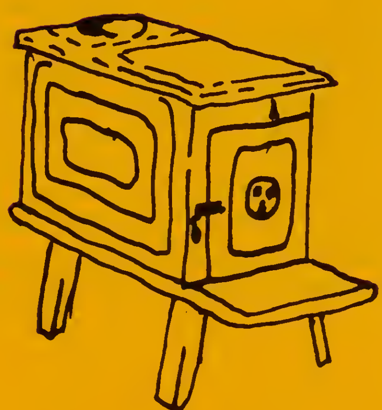
Older thermostats may have problems with corrosion of the contact points. They can be cleaned with a piece of bond paper or crocus cloth. (Be sure to shut off the power to the thermostat before you start to work.)

ENERGY CONSERVATION BULLETIN 2.6.1
Fireplaces

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

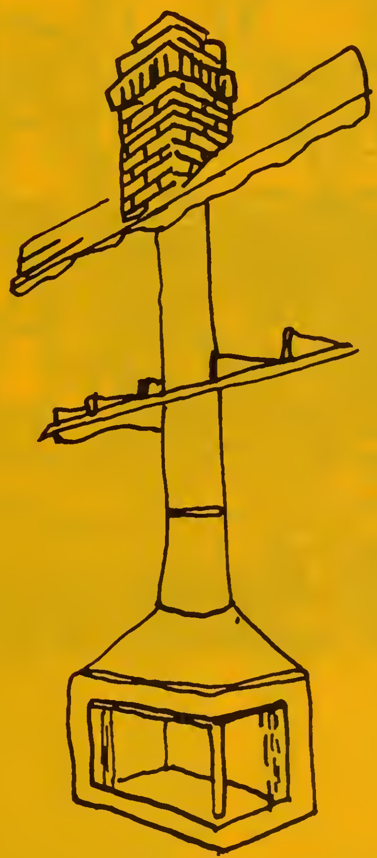
Free Standing Fireplaces and Wood Stoves

Under $700.
Light weight (can be installed on existing floors).
Wood Stoves have high efficiency. Free Standing Fireplaces have poor efficiency.
Pre-engineered to function properly.
Can be installed by most do-it-yourselfers.
May have shorter life than masonry fireplace (thin metal units may burn out.)
Must be placed a certain distance from walls and other combustible material.



Pre-Built Installed Fireplaces

Between $500-$1500.
Medium weight (can usually be installed on exisiting floors).
Slightly higher efficiency than solid masonry type.
Pre-engineered to function properly.
Can be installed by most do-it-yourselfers.
Glass door fire screens should be used.
Adds to home value.



Masonry Fireplaces

Between $100-$3000
Very heavy (needs separate foundation). Low efficiency — 10% or less — (higher efficiences available with heat circulating metal form type).
Should be built by qualified mason (one mistake can be very costly).
Should have outside draft and combustion air supply.
Glass door fire screens should be used.
Has traditional appeal and charm.
Adds more to home value than other units.

Mobile Home Fireplace

Between $350-$500.
Similar to pre-built installed fireplace but with these differences:

Air for the fireplace must be brought in from outside.
No dampers are permitted on the combustion air inlet or flue gas outlet.
There must be a door to close off the fireplace.
The door, usually glass, should be kept closed except when adding fuel.
Chimney must have a spark arrester.
Wood, coal, or charcoal may be burned.
Unit must carry seal of Underwriters Laboratories (UL). If it doesn't, it likely does not meet the above standards and shouldn't be used in your mobile home.

Your local library has books containing dimensional data and technical information on building and installing fireplaces.

ENERGY CONSERVATION BULLETIN 2.7.1

Heat Pumps

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Despite its name, a heat pump is designed to provide summer cooling as well as winter heating. In other words, a heat pump replaces both furnace and central air-conditioning equipment with a single heating-cooling system.

Most heat pumps are compact units that, except for indoor components, are installed outside the home. In size and appearance they look like the outdoor unit of central air conditioner.

In summer, a heat pump operates as a standard, electrically driven, air conditioner, collecting heat from the air in your home and expelling it outside.

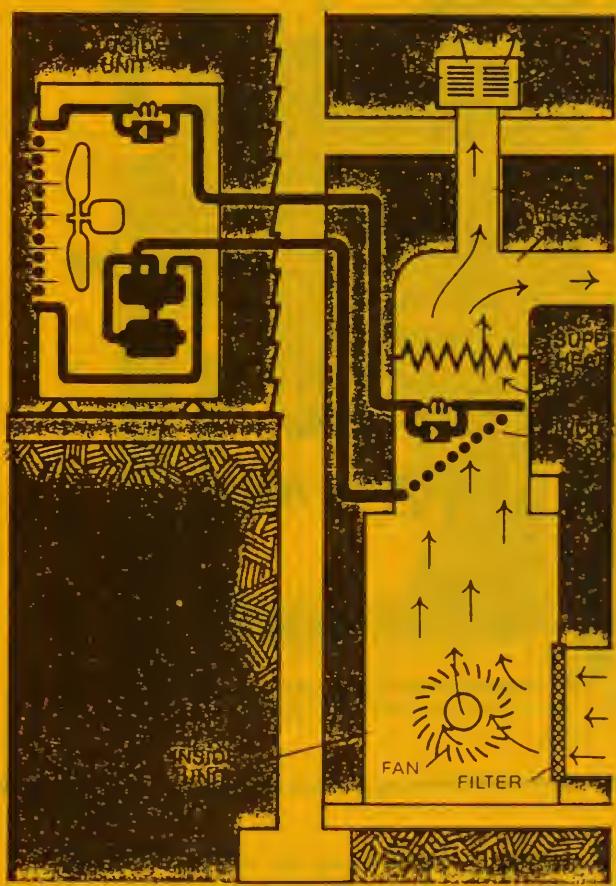
In winter, the process is reversed so that the heat pump collects heat from outdoor air to warm the air inside your home.

The heat pump can do this because heat exists in all air. Even cold winter air (down to minus 460°F.) contains heat. For the colder days, most heat pump installations have a booster electrical resistance heater that automatically switches on to supplement the heat brought in from outside.

Heat pumps generally don't function efficiently once the temperature drops below freezing. So if very cold days are the norm where you live, a heat pump may not be the most cost-effective option. The industry is presently addressing itself to this problem and alternative designs which, for example, extract warmth from solar collectors or from ground water may increase the temperature range at which heat pumps operate.

How does the heat pump save energy? It's the heating cycle that accounts for the significant energy savings that are produced by heat pumps. Unlike a furnace that turns fuel or electricity into heat, the heat pump collects heat that already exists in the outdoor air by means of its refrigeration cycle. This means that the heat pump can supply from one-and-ahalf to two-and-a-half times more heat than the energy it uses. Engineers refer to this advantage of the heat pump as the efficiency or Seasonal Performance Factor (SPF). The higher the SPF, the more efficient the unit.

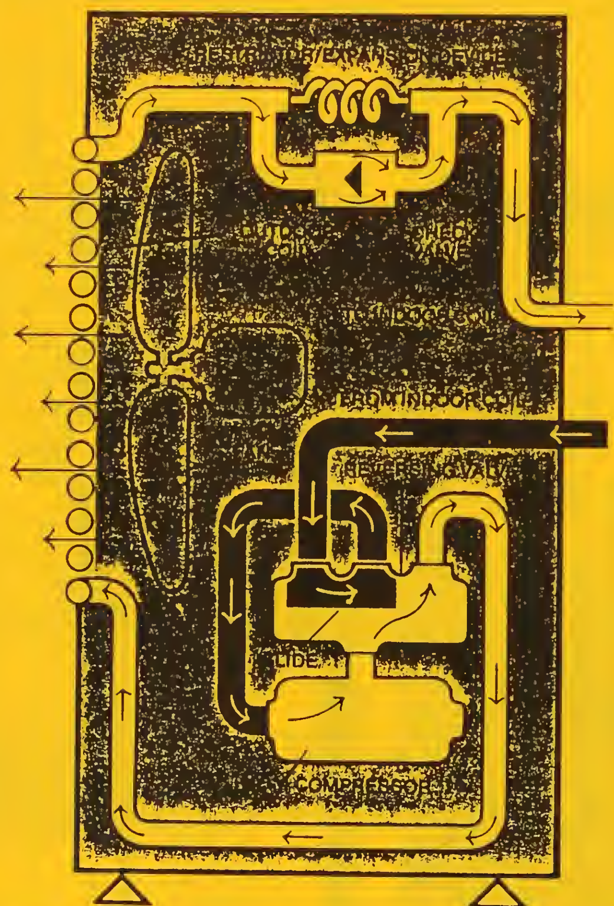
In a typical heat pump installation in a home, the outdoor unit contains the outside coil, compressor and reversing valve. Refrigerant travels through pipe or tubing to the inside coil located in the path of air circulated by inside fan. The supplemental electric heater above the inside coil is activated when the heat loss of the building exceeds the heat pump output on colder days.

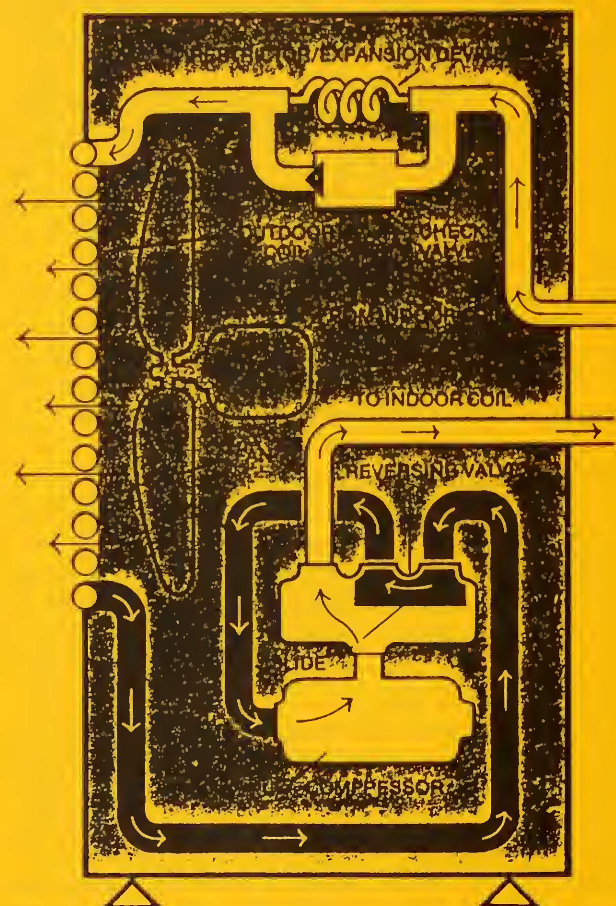


These schematic drawings show the inner workings of a heat pump.

Cooling cycle. Refrigerant passes through inside coil, evaporating from a liquid to a vapor. As the liquid evaporates, it absorbs heat, cooling the air around the coil. An indoor fan pushes this cooled air through ducts inside the house. Meanwhile, the vaporized refrigerant, laden with heat, passes through a compressor which compresses the vapor, raising its temperature and pressure. The reversing valve directs the flow of hot, high pressure vapor liquid to the outside coil, the heat released during condensation is fanned into the outside air, and the cycle begins again.

Heating Cycle. Note that the valve inside the reversing mechanism has shifted, causing the refrigerant flow to reverse. Liquid refrigerant now flows to the outside coil, picking up heat as it evaporates into a low pressure vapor. The vapor travels through the compressor where it is compressed into a hot, high pressure vapor, then is directed by the reversing valve to the indoor coil. The vapor turns to liquid as it passes through the indoor coil, releasing heat that is pushed through the ducts inside the house by the indoor fan.

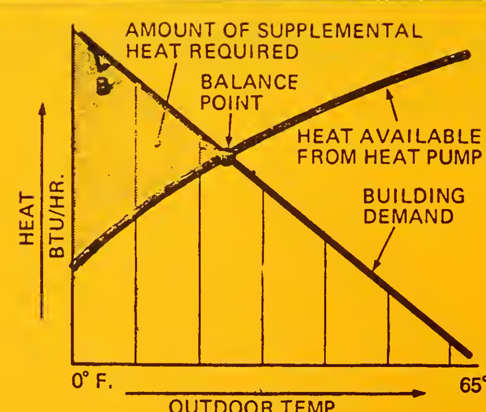




If you are buying a heat pump for the first time, you should be aware of some of its features that are somewhat different from the conventional central system.

1. The Balance Point

   The heat pump compressor itself will provide all the heat your home needs until the outdoor temperature drops down to what is known as the "balance point." This is usually about 30 degrees. Below this point auxiliary resistance heat will automatically switch on, supplementing the heat from the compressor and maintaining the comfort level in your home.



As outdoor temperature rises, heat-pump output [line A] increases, while building's heat requirements [line B] decreases. Below the balance-point temperature, the heat pump cannot meet the building's heat demand, and a source of supplemental heat must be turned on.

2. Lower Supply Air Temperature
   During the heating season, the heat pump circulates a larger quantity of lower temperature air than you may have been accustomed to in a home with a conventional central furnace. But don't be concerned about this lower temperature air coming from your registers. Your heat pump will provide pleasant heating.
3. The Defrost Cycle
   During the heating season, your outdoor coil will occasionally collect frost and ice. The rate of collection depends upon the outdoor temperature and relative humidity. In order to maintain proper air flow over the coil, the unit will automatically "defrost" itself. Most of the time you will never realize this is taking place. But on rare occasions the unit will appear to smoke or steam. This is a normal operating condition, so don't let it alarm you.

Also consider:

*Initial cost. Get two or three contractors to estimate the installation cost of a heat pump for your home versus the cost of an alternative heating-cooling system.

On the average, heat pumps have a higher initial cost than other heating-cooling systems. The higher cost is a reflection of the durability that must be built into the heat pump for year-round operation in hot and cold weather, and of the heat pump's sophisticated control mechanisms.

Despite the higher installation cost, the heat pump's efficiency can produce significant savings on monthly heating costs. This makes it possible for the cost of owning and operating a heat pump to be comparable to or lower than alternative heating-cooling systems, depending on the cost of energy and the severity of the winter.

*Payback. Figure out how many years it will take for your heat pump to pay back its higher initial cost with lower annual operating costs. You can do this by dividing the estimated annual operating savings into the extra cost you'd pay for a heat pump installation.

Heat Pump Rating

1. Energy efficiency Ratio (EER)
   The EER is a measure of their cooling capacity — in BTU's per hour — divided by the electricity they consume — measured in watts.
   As a general rule, 7.0 is good; anything rated at 8.0 or higher is excellent.
   A unit with an EER of 9 uses one-third less energy than one with EER-6.

2. Coefficient of Performance (COP)
   The efficiency of heat pumps for heating is measured by their Coefficient of Performance (COP), an industry yardstick. Electric resistance heating has an efficiency of 100 percent, or a COP of 1.00.
   This ratio is calculated by dividing the total heating capacity provided by the refrigeration system including circulating fan heat but excluding supplementary resistance heat, (Btuh) by the total electrical input (watts) x 3.412.

$$\text{COP} = \frac{\text{BTU per hour (output)}}{\text{Watts per hour (input)} \times 3.412}$$

3. Seasonal Peformance Factor (SPF)

   During the heating season, the heat pump's Coefficient of Performance increases on mild days and decreases on cold days. The average COP for the heating season (the Seasonal Performance Factor) therefore is higher in a mild climate than in a region where winters are severe.

ENERGY CONSERVATION BULLETIN 2.8.1

Air Conditioning

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I — Refrigeration Type Air Conditioners

A simple explanation will clarify the operation of air conditioners.

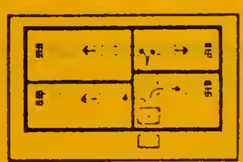
Liquids absorb heat as they vaporize to gas and lose it again when they return to liquid state. If the heat is absorbed inside a house and lost outside, the house is cooled. Refrigerants do this very efficiently by vaporizing (boiling) at low temperatures.

In an air conditioner, warm air from the house is passed over coils of cold liquid refrigerant and returned to the house by a fan. In absorbing heat from this air, the refrigerant becomes gas. A compressor "squeezes" the warm gas, concentrating its heat, and it enters condenser coils. Another fan blows outside air over these coils and cools the gas back into liquid. The cycle then continues.

As the inside air is cooled, it must give up moisture — it is dehumidified.

When you buy a cooling system, compare the Energy Efficiency Ratio (EER) of various brands. EER indicates the number of cooling BTU's delivered by a cooling system for each watt of electrical input. The higher the EER, the less energy required for the same amount of cooling. The EER will be a number ranging from 4.7 to 12.2. You can figure the EER of a unit you already own by dividing its capacity in BTU's by its wattage rating. An 18,000 BTU air conditioner rated at 3000 watts would have an EER of 6, which is only fair. If you purchase the unit with the higher EER, even though it costs more initially, you will probably save more in electricity costs in the long run. Buy the cooling system with the smallest capacity that will do the job.

Buy a unit with the capacity that matches your needs. An over-sized unit not only will cost more, but will operate inefficiently. If you can't match your cooling needs to a unit's capacity, go with a slightly smaller unit.



Central System

A duct system distributes cool air to every room from a central unit.

•More effective than window or thru-the-wall unit.
•Dehumidification.
•Air filtered.
•Heating system can be added, using existing ductwork.
•Increases value of home.

Consider central air conditioning if you consistently operate a number of room units. Installing central air conditioning requires a dependable contractor. A solid reputation counts.

Window Unit

May be placed in any window large enough for the unit and where there is or can be adequate wiring. Unit should be shielded from direct sunlight.

•Inexpensively installed in any home.
•De humidification
•Air filtered.

Thru-The-Wall Unit

Should be placed as high above floor as practical on outside wall that is shielded from direct sunlight.

•Dehumidification.
•Air filtered.
•May be installed in existing home.

•Turn off your window air-conditioners when you leave a room for several hours. You'll use less energy cooling the room down later than if you had left the unit running.

•Place room air conditioning units on the cool (north) side of the house, if possible. If your air conditioner is in direct sunlight, cover it with an awning, but make sure it does not trap hot air in the window area.

•A room air conditioner of adequate capacity can serve a zone much larger than a single room, providing construction of the building is such as to permit the free circulation of air in the area.

•If you have a room air conditioner, be sure that the air exchange control, which is a means of bringing in outside air to replace stale air, is closed during the day. When it is open on hot days, this outside air, which is inefficient to cool is being introduced into the system.

•Set your thermostat at 78 degrees, a reasonably comfortable and energy-efficient indoor temperature.

The higher the setting and the less difference between indoor and outdoor temperature, the less outdoor hot air will flow into the building.

•Don't set your thermostat at a colder setting than normal when you turn your air-conditioner on. It will NOT cool faster. It WILL cool to a lower temperature than you need and use more energy.

•Set the fan speed on high except in very humid weather. When it's humid, set the fan speed at low; you'll get less cooling but more moisture will be removed from the air

•Clean or replace air-conditioning filters at least once a month. When the filter is dirty, the fan has to run longer to move the same amount of air, and this takes more electricity.

•Don't put anything directly in front of your air conditioner. Furniture, draperies, and other objects will block the flow of cool air.

•Never operate a window or attic fan in an air conditioned area. If will simply force the cooled air out of the room.

•Keep all windows and doors closed while your air conditioner is in operation.

•Expect three benefits from a service call for your air conditioner: cleaning the filters, checking the refrigerant in the system, and cleaning the condenser.

•Confine your living spaces to fewer rooms, and close off the rooms you are not using.

2 — Evaporative Type Air Conditioners

•In dry climates such as Colorado, it is wise to consider evaporative cooling. These devices, which use less energy, evaporate water to lower the temperature of a stream of outdoor air circulated through the house.

To insure maximum efficiency from an evaporative cooling unit, replace the cooling pads at the beginning of the summer season. Clean the unit thoroughly and oil motor and blower bearings. Check the water pan and recirculation system for leaks.

Test the unit to make sure that the water distribution lines keep the entire pad surface wet but don't flood the pads, which will restrict air flow.

Air balance each room. Open the window furthest from the cooler duct in each room about one inch. Unlike refrigeration, evaporative coolers depend on open windows to work properly.

3 - Cooling Without Air Conditioning

It is possible to maintain a comfortable home in summer in parts of Colorado without relying on a mechanical cooling system. As a matter of fact, many families do. Most of the suggestions already offered on proper insulation are as beneficial to cooling in summer as they are to heating in winter.

A number of the ideas offered in this section, while aimed at reducing air conditioning loads, are just as useful to families who do not use air conditioning.

•Take advantage of the daily temperature cycle — to invite night's cool air into your home and to button up the house come morning. Lowest air temperatures usually occur from midnight to just before dawn.

•A new house can be oriented to take advantage of solar and climatic conditions. Rooms can be oriented accordingly — bedrooms, for example, might be located in the east so they will not receive the rays of the late afternoon sun.

•When ventilating, draw in air from the coolest side of the house. Expel warm air from the upper parts of the house, either into the attic or through windows near their tops. A ventilator fan can be effectively installed into the upper ceiling to pull air through and push it into the attic. Also, consider installing an attic fan to exhaust heat which often reaches 140° - 160°, thus preventing the heat from radiating down to your living area.

•Take advantage of all possible ways of reducing solar heat gain. Remember to draw the blinds and draperies of windows exposed to direct sunlight. Awnings can be a more permanent method.

•Plant deciduous trees on the sunny sides of the house for summer cooling.

•On cooler days and during cooler hours, open the window or use attic or window fans instead of an air conditioner; the cooling breeze will be even more enjoyable since it is much cheaper to operate a fan than an air conditioner.

ENERGY CONSERVATION BULLETIN 2.9.1
Humidity Control

Intermountain Rural Electric Association 303 794 1535
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Types Of Humidifiers

In tightly built modern houses, too little humidity is seldom the problem. However, in large houses with few occupants or in houses where little cooking or clothes washing or drying is done, there could be a problem of dry air in the winter. Moisture can be added mechanically by commercially available humidifiers. There are three general types available:

The pan type is the simplest but has limited capacity. The pan is inserted in the plenum of the furnace and wicking plates are used to draw water out of the pan where it is then evaporated into the air stream flowing over the plates.

The wetted-element type operates as air is forced through a wetted pad or filter. These units can be either portable or mounted on the furnace. Portable units are usually refilled manually and require more attention than the permanently installed humidifiers.

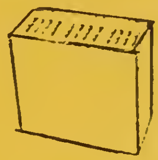
The atomizing type throws water in fine droplets from the surface of a rapidly revolving disk or a small nozzle. This type is available as a portable unit or installed in the duct or plenum of a central heating system. The minerals in hard water are left as the water evaporates, and a light coating of white dust can result over much of the furnishings in the house. In the two types previously listed, the minerals remain in the plates or pad and are discarded as their parts are replaced.

Humidifiers are controlled by humidistats and should be closely watched so that high humidity does not occur on extremely cold days when condensation is most likely to occur. Moisture accumulation on the inside surfaces of double glazed windows is the first indication of excessive humidity. If the outdoor temperature is 0° to 10°, the humidity should be no more than 20 percent; if 15° to 45°, 40 percent.

In the winter, a humidifier can relieve uncomfortable dryness, but it won't reduce utility bills. Don't believe advertisements telling you otherwise.

Humidity Control Equipment

Portable Humidifier



Place where needed.
- Easily moved.
- Lower initial cost than console.
- Automatic operation.

Console Humidifier

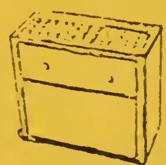
Place in central location about six inches from a warm, inside wall.

- Large capacity.
- Automatic moisture dispersion.
- Some models have automatic water refill.

Ventilating Fan

Placed in wall or ceiling of kitchen and bath.

- Operated only when needed.
- Can be automatically controlled by humidistat.



Dehumidifier

Placed near sources of excess water vapor, such as kitchen or bathroom.

- Easily moved.
- Automatic dehumdification.
- Some units have automatic drain.

ENERGY CONSERVATION BULLETIN 3.2.1

Kitchen Appliances

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While you're thinking about your food budget, think about your energy budget too. The meals you prepare, what you cook in and how you cook can make a difference

Range & Oven

•Preheating is no longer recommended by some oven manufacturers; consult the operating manual. If preheating is needed, don't wait longer than 10 to 12 minutes. Once it is preheated, immediately put the product to be baked into the oven. Many casseroles and meats do not need a preheated oven. The broiler does not require preheating unless a recipe specifically calls for it.

•Cook by time and temperature for best results. Use a meat thermometer when roasting to prevent overcooking and additional energy costs. Careful timing of cooking procedures eliminates the need to check food constantly. Every time you peek under the lid of a pan, heat is lost.

•Heating elements on an electric stove store a great amount of energy even after they are shut off. You can continue to cook after this shut-off period for about two or three minutes. Electric oven retains heat from 15 to 30 minutes. Use leftover heat to warm plates or heat rolls.

•Place your pans on the range before you turn it on to save heat. Be sure to match pots and pans to the right size unit so you don't waste heat around the sides of the vessel.

•Keep the kitchen clean. Make sure that the appliances are operating economically by regularly cleaning the exhaust fans, range top and oven.

•Clean reflector pans under surface units of an electric range will increase efficiency.

•Never boil water in an open pan. Water will come to a boil faster and use less energy in a kettle or covered pan. As soon as water reaches the boiling point, you can cut the setting back.

•Try to cook food on lowest possible setting. Many times high heat will overcook food and waste energy. The lower the setting the less energy used. (Potatoes will boil just as well at medium heat as at high heat.)

•Use a small amount of water to cook vegetables. They will cook faster, taste better and contain more vitamins. If the oven is to be used, then cook the whole meal in it. Leave 1½ inches between pans and there will be no absorption of odors.

•Preparing larger quantities of food is a good way to conserve energy. Stews, soups, spaghetti sauce, and casseroles should be prepared ahead and then frozen. It cost less to store and warm them as needed than to cook them from scratch for each meal. Besides this saves a good deal of time in the kitchen, time that can be better used somewhere else.

•A self-cleaning oven is designed with thicker insulation and uses less energy for normal oven cooking than ranges without the self-cleaning feature. A major manufacturer reports that tests conducted by its engineers have shown that a self-cleaning oven uses about 15% less energy than a non-self-cleaning oven. This margin of energy conserved is equal to the energy needed for 12 oven cleanings per year.

•Do not use aluminum foil to line the oven unless manufacturer's instructions permit it. It can reduce the oven's efficiency by interfering with air crculation.

•Plan outdoor meals. Especially in the summer, outdoor barbecues are fun, save energy and keep the house from heating up.

•Energy can be saved by using alternative cooking methods such as electric frypans, broilers, crock pots, toaster-ovens, rotisseries and microwave ovens. Many of these appliances also cut down on dishwashing by cooking more than one thing at a time in a single container. An electric frypan can be used to cook several items at a time by dividing the interior with an aluminum foil insert. It will heat more efficiently than a pan on the stove because the electric heating element is part of the pan. This gives even, well distributed heat on entire surface of the fry pan.

•Use these appliances as the manufacturer suggests. Never pull the cord when disconnecting an appliance from the outlet . . . use the plug.

•Set up a summer kitchen outdoors to eliminate all cooking heat, moisture, and odors from the house. Appliances such as skillets, pressure cookers, and toaster ovens can easily be used out on the patio.

•Investigate recipes. Many of these appliances are very versatile and can cook a wide range of items. For instance, a crockery slow cooker can be used to cook soup, roasts, bread and even cake.

•Another great alternative is the electric barbeque. It not only saves pan washing, but doesn't heat up the kitchen. Many feature special easy-to-clean grills, too.

Dishwashing

•The average dishwasher used 14 gallons of hot water per load. Use it in an energy efficient manner.

•The "rinse-hold" control on dishwashers uses three to seven gallons of hot water each time used. Avoid using it.

•Scrape dishes before loading them into the dishwasher so you won't have to rinse them. If they need rinsing, use cold water. Also check the filter screen over the drain in the dishwasher regularly and remove any food particles.

•Load the dishwasher correctly in order to ensure operating efficiency.

•Use the manufacturer's directions in measuring detergent. Too much detergent will over load the machine and cause it to work inefficiently.

•Be sure your dishwasher is full, but not overloaded, when you turn it on.

•When buying a dishwasher, look for a model with air-power and/or overnight dry settings. These features automatically turn off the dishwasher after the rinse cycle.

•Use a steamer or pressure cooker to cook several foods at one time when possible. Many pressure cookers have partition inserts so three or four items can be cooked at once. A pressure cooker takes less energy and time than conventional cooking.

•Slow-cookers consume very small amounts of electricity and do not overheat living spaces — try using yours instead of your oven.

•Research on energy consumed in cooking indicates that microwave cooking is the best energy conserver. It is four times as efficient as conventional cooking. There is no preheating and no heat given off into the kitchen.

•Remember, heating elements are the greatest pullers of wattage we have in our home. Plan their use wisely. Appliances with heating elements are: toasters, electric heaters, irons, electric stoves, hair dryers, waffle irons, electric blankets, coffee makers and others.

•If your washer has no "air-dry" switch, turn the control to "off" position after the last rinse, crack the door and let the dishes air-dry by themselves. You'll save a third of the energy cost of automatic dishwashing.

•Don't wash dishes under hot running water or you'll be throwing away gallons of costly heated water. Close the drain, fill the sink with warm water and detergent, and rinse with a hot spray in the dish drainer.

•Install an aerator in your kitchen sink faucet. By reducing the amount of water in the flow, you use less hot water and save the energy that would have been required to heat it. The lower flow pressure is hardly noticeable.

•Use cold water rather than hot to operate your food disposer. This saves the energy needed to heat the water, is recommended for the appliance, and aids in getting rid of grease. Grease solidifies in cold water and can be ground up and washed away.

Refrigerators

•When buying a new refrigerator, consider that the self-defrosting type uses more electricity than the manual defrost type.

•Most refrigerators have heating elements in their walls to prevent condensation on the outside. These heaters need to be on only when the air is very humid. If you buy such a refrigerator, be sure it has a switch to turn off the heater. Make sure that the refrigerator is the best size for the family needs. A half empty refrigerator is wasting energy.

•Check seals around the refrigerator and oven doors to make sure they are air tight. If not, adjust the latch or replace the seal.

To check the tightness of the seal, place a dollar bill between the gasket and the cabinet of the refrigerator and close the door. Pull the dollar bill straight out. There should be some resistance. Test all around the door. If there are places where no resistance is noticeable, have the gasket checked or replaced.

• Don't keep your refrigerator freezer too cold. Recommended temperatures: 38 to 40 degrees for the fresh food compartment of the refrigerator; 5 degrees for the freezer section. (If you have a separate freezer for long-term storage, it should be kept at 0°F., however.)

•Buy an inexpensive refrigerator thermometer to keep a check on the inside temperature.

•Every time the door is opened, cold air rushes out and the refrigerator or freezer has to work hard to compensate for the loss. Plan ahead and know what is needed before opening the door. When unpacking groceries from the store, stack all the refrigerated and frozen items in separate piles. Then put them in the refrigerator all at one time, opening the door only once.

•Assure proper ventilation to lower refrigerator and freezer operating costs. Install the unit in an area with adequate air flow and clearance from the walls and cabinets.

•Open your refrigerator and freezer as seldom and for as short of period of time as possible.

•Locate the appliance away from the direct flow of warm air such as that from a range, heat register or sunshine.

•Cool foods before refrigerating. Be careful, however, not to let things set out any longer than it takes to come to room temperature. That way, bacteria won't have a chance to grow.

•Cover all liquids stored in the refrigerator (especially frost-free models). Moisture is drawn into the air from uncovered liquids making the refrigerator work harder. When the refrigerator or freezer is full, allow for air ciculation around the stored items for proper cooling.

•Manual refrigerators and freezers consume less energy than those that defrost automatically. But they must be defrosted frequently and quickly to maintain that edge. Frost should never be allowed to build up to more than ¼ inch.

•Once a year vacuum out the back of your refrigerator. Pull it out from the wall, disconnect the electric plug and vacuum the large expose coil which usually runs the length of the refrigerator.

•While on vacation, raise the temperature setting slightly. Since the door won't be opened, things will stay cold. If the vacation is going to be for more than a week, refrigerators and freezers may be cleaned out, turned off, unplugged, and left open.

•Keep an up-to-date inventory of the food in your freezer. Indicate the location of each item. When you want something, you'll know where it is. Then the freezer cover or door won't have to be open so long.

•A chest freezer allows less cold air to escape when opened than does an upright since cold air settles to the bottom.

•Use an ice bucket when ice is going to be used for several things. This will prevent having to open the door repeatedly to fill a single glass.

ENERGY CONSERVATION BULLETIN 3.3.1

Laundry Appliances

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

You can save considerable amounts of energy in the laundry through conservation of hot water and by using your automatic washers and dryers less often and more efficiently.

Make sure that the washer and dryer are the right size for the family. A machine that is too small will waste energy by making it necessary to do two or three loads when a large machine could have done one.

Keep laundry equipment clean. Clean the lint filters on both machines after each load. A clogged lint trap or filter reduces efficiency and increases energy use.

Washers

One of the greatest energy users and costs in washing clothes is the heating of the water. So think cold.

- Experiment with the best way of washing for the family. To avoid overwashing, which wastes water and energy and shortens the life of clothing, try presoaking soiled things.
- Always presoak badly soiled clothes.
- If your machine has a soak cycle, take full advantage of it. You might be able to remove stubborn stains with just one washing.
- Don't use too much detergent. Follow the instructions on the box. Oversudsing makes your machine work harder and use more energy.
- Use the suds saver if you have one. It will allow you to use one tubful of hot water for several loads.
- Don't wash partial loads. Wait until you can fill the machine. You'll save time, electricity and hot water. A full load is when the tub is three-quarters full of dry, loosely packed articles.
- If you must wash a partial load select the water level to fit the amount of clothes. Some machines have "mini cycles" which allow for just this use of the washer.
- Wash clothes in warm or cold water, rinse in cold. Use hot water only if absolutely necessary. Many detergents are designed to clean just as well in cold water. Your clothes will fade less and have fewer wrinkles. That might save you some ironing too.
- Short cycles. If your washer has a timer, use the shortest cycle possible. Regular clothes need only an 8-10 minute wash. Delicate clothes don't need as long a wash cycle as dirty work clothes.
- Clean the filter to make your machine run efficiently. Some machines have a self-cleaning filter, in which case, it will take care of itself.
- If you have a laundry tub next to your washer, save the hot sudsy water from the wash to clean barbecue grills, garden tools, oven racks, etc.
- Shut off the water supply to the washer when it is not being used. This prevents loss and damage in the event of a broken hose, as well as relieving pressure on the water valves. It is a good idea to shut off the water when leaving on vacation, too.

Dryers

- Separate drying loads into heavy and lightweight items, since the lighter one takes less drying time.
- Two half-loads take less time and require less electrical energy to dry than one full load in many cases.
- Specific drying settings are recommended for different fabrics. Follow the directions. You don't need "hot" heat for permanent press, for example. The "Warm" setting will dry some items wrinke free, if you remove them as soon as they are dry.
- Fill clothes dryers but do not overload them. That makes it work harder and longer. It wastes electricity and money.
- Dry your clothes in consecutive loads. The energy used to bring the dryer up to the desired temperature shouldn't be allowed to go to waste.
- Use leftover heat to dry light synthetic garments and only partially dry items which are to be pressed immediately.
- Set your dryer for "damp dry" if you are drying clothes that require ironing. Or take them out while they are still a little damp . . . and just right for ironing. Remove clothing that needs to be pressed before they are completely dry and damp press.
- "Over-drying" is the most common waste of electricity. And over-drying causes wrinkles and makes clothes wear out faster.
- If your dryer has an automatic dry cycle, use it.
- Save energy by using the old-fashioned clothesline. As a bonus, outdoors in fine weather clothes get a fresh sunshine smell. On bad winter days, if you have a warm cellar and some extra space, consider hanging a clothes line to dry clothes.
- Keep the lint screen in the dryer clean. Remove lint after each load. Lint impedes the flow of air in the dryer and requires the machine to use more energy. Your clothes will come out better as well.
- Try to place the dryer in a warm area of the home. Your dryer will have to operate longer in an unheated garage or utility room because the cool air taken in must be warmed more than air that is already warm.
- Vent your dryer to increase its efficiency. Occasionally check the vent to make sure it is not clogged. A clogged vent can cause your dryer to consumer needless energy and presents a potential fire hazard.

Ironing

- When possible, do all the ironing at one time to prevent having to heat the iron several times a day or week. Use the stored heat in the iron after it is turned off to press delicate fabrics. When the iron is off, unplug it.
- You can save ironing time and energy by "pressing" sheets and pillow cases on the warm top of your dryer. Fold them carefully, then smooth them out on the flat surface.
- Save energy needed for ironing by hanging clothes in the bathroom while you're bathing or showering. The steam often removes the wrinkles for you.

ENERGY CONSERVATION BULLETIN 3.4.1

Other Appliances

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The foundation of satisfactory electrical use is the home wiring system. If the wiring system is not big enough to carry the home's load, efficient operation of the appliances and electric equipment can be impaired. Be sure that there is adequate wiring for the family appliances.

Do not use extension cords if possible.

Make sure that an appliance is off before plugging it in. when unplugging, grasp the plug and not the cord.

- If a three-prong plug won't fit the socket, don't remove the third prong; get an adapter for the wall socket.

- Don't overload electrical circuits. This results in reduced energy efficiency and also can create a safety hazard. If you're unsure of circuit capacity or attached load, call your electrician.

- Become thoroughly familiar with the operation of all your appliances. Read the ''use and care'' book to make sure you are not wasting energy by using the appliance incorrectly.

- Don't put off needed repairs. Worn parts may increase energy use needlessly as well as putting excessive wear on other parts. This will cause more costly repairs later.

- Keep moving parts of appliances free from dust and grime so they can move freely.

- Heating elements are the greatest pullers of wattage we have in our home. Plan their use wisely. Appliances with heating elements are: toasters, electric heaters, irons, electric stoves, hair dryers, waffle irons, electric blankets, coffee makers and others.

- Before buying new appliances with special features, find find out how much energy they use compared with other, perhaps less convenient, models. A frost-free refrigerator, for example, uses mor energy than one you have defrost manually. It also costs more to purchase. The energy and dollars you can save with a manual-defrost model may be worth giving up the convenience.

- Another source of wasted energy can be easily controlled by simply taking care to turn off radios, televisions, stereos or any other kind of appliance when not being used.

• As a general rule, small appliances use less energy than large ones. Therefore, using a small appliance in place of a large one whenever possible conserves energy. For example: toasting bread in the oven uses three times more energy than toasting it in a toaster.

• While all of of the small appliances in the house generally will add on more than a few dollars to the monthly electric bill, it is still wise to extend good energy use habits to them too.

•Items like electric clocks are low wattage users, and they don't contribute very much to your bill. Similarly, items that are used for brief periods, like carving knives, tooth brushes, and small tools, have very little effect on your bill.

•When no one is watching television or listening to the radio, sets should be turned off. Instant-on TV sets draw electricity 24 hours a day. Some sets have switches to turn off the instant-on feature during hours when not in use. If you do not have this feature, unplug the TV set. As an alternative you can buy a special extension cord with an OFF-ON switch at its end or check with your TV serviceman to see if he can place an on-off switch on the cord to the wall plug.

•If buying a new TV set, look for the solid-state type. It uses less power than the older tube type. Color television sets use more electricity than black-and-white sets.

•Do not pre-heat appliances such as stoves, frypans, irons and the like any longer than necessary; these are big energy-users.

•A vacuum cleaner will operate more efficiently if it is cleaned and the bag is emptied regularly. Watch for a buildup of hair or string on the brushes which slows their movement and impedes the cleaning ability. Never vacuum over electric cords.

•Electricity has made many jobs easier in the home workshop. To help keep all electrical servants working well, follow a procedure of regular maintenance and cleaning of all equipment.

Always make sure there is a good connection. Avoid accidental starting of appliances by making sure the switch is off before plugging in the cord. Also, disconnect tools before servicing or changing accessories.

Ground all tools unless they are double insulated. Never remove a third prong from a plug . . . get an adapter.

Never carry a portable tool by the cord.

•Take showers rather than tub baths but limit your showering time and check the water flow if you want to save energy. It takes about 30 gallons of water to fill the average tub. A shower with a flow of 4 gallons of water a minute uses only 20 gallons in 5 minutes. Assuming you use half hot and half cold water for bathing, you would save about 5 gallons of hot water every time you substitute a shower for a bath. Thus, if you substituted just one shower for one bath per day, you would save almost 2,000 gallons of hot water in a year.

•Consider installing a flow restrictor in the pipe at the showerhead. These inexpensive, easy-to-install devices restrict the flow of water to an adequate 3 to 4 gallons per minute. This can save considerable amounts of hot water and the energy used to produce them over a year's time. For example, reducing the flow from 8 to 3 gallons a minute would save the average family about $24 a year.

•Don't scrub nails or wash hands under a running stream. Fill sink for washing and rinsing. You use half as much heated water.

•A leak of one drip per second in a hot water tap will pour 2,500 gallons of hot water down the drain over a one year period. You pay not only for the water, but the fuel it takes to heat it.

•While you're on vacation, give your energy bill a break too. Turn your electric water heater off at the circuit breaker. When you return, run some water from a hot water faucet to make sure there is water in the heater.

ENERGY CONSERVATION BULLETIN 3.4A.1
Appliances: Energy Use And Operating Costs

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This table lists common household appliances, their average wattage, the national average usage and the average cost to operate that appliance for one month. The purpose of this table is to point out to you, the Intermountain member consumer how your home uses electricity.

It should be emphasized that these are only national averages. Individual households can and do vary widely depending on the efforts made in each home to save money by conserving electricity.

		Average Wattage	Average Hours Used per Month	Aprox. KWH Used per Month	Avg. cost per Month at 3½cents per KWH
FOOD PREPARATION	Blender	386	3	1.3	$ .05
	Counter Top Oven/Broiler	1,436	6	8.5	.30
	Coffee Maker	894	10	9	.32
	Dishwasher	1,201	25	30	1.05
	Frying Pan	1,196	13	15.5	.54
	Hot Plate	1,257	6	7.5	.26
	Mixer	127	8.5	1	.04
	Microwave Oven	1,450	11	16	.56
	Range with Oven	12.200	8	98	3.43
	with self-cleaning oven	13,200	8.25	100	3.50
	Toaster	1,246	3	3	.11
	Trash Compactor	400	1	4	.14
	Waffle Maker	1,116	1.5	2	.07
	Waste Disposal	445	6	2.5	.09
FOOD PRESERVATION	Freezer (15 cu. ft.)	341	292	100	3.50
	Freezer (frost free 15 cu. ft.)	440	333	147	5.15
	Refrigerator/Freezer (14 cu. ft.)	326	291	95	3.33
	Refrigerator/Freezer (frost free 14 cu. ft.)	615	248	152	5.32
COMFORT CONDITIONING (Seasonal-all figures will vary depending on weather and specific size of unit.)	Air Conditioner (room)	860	360	309	10.82
	Electric Blanket	177	69	12	.42
	Dehumidifier	207	244	63	2.20
	Fan (window)	200	141	28	.98
	Heater (portable)	1,322	45	59	2.07
	Heating Pad	65	13	1	.04
	Humidifier	177	72	41	1.44
	Lights (small home)	1,000	Varies	100	3.50
	Lights (large home)	4,000	Varies	200	7.00
HOME HEATING (Figures are for highest month of heating season.)	Heat Pump (2½ ton for 1200 sq. ft. home at 30° outside)	3,110	540	1,679	58.77
	Baseboard Heater (1000 sq. ft. house)	8,000	300	2.400	84.00
	Baseboard Heater (1600 sq. ft. house)	12,000	300	3,600	126.00
	Oil Furnace (blower, etc.)	600	125	75	2.63
	Electric Furnace (1200 sq. ft. house)	20 000	540	4,800	168.00
HEALTH AND BEAUTY	Hair Dryer	1,000	3	3.0	.11
	Electric Razor	14	10	.2	.01
	Tooth Brush	7	6	.04	1/10 cents
LAUNDRY	Clothes Dryer	4,856	17	83	2.91
	Iron (hand)	1,008	12	12	.42
	Washing Machine (non automatic)	286	22	6	.21
	Washing Machine (automatic)	512	17	9	.32
	Water Heater (quick recovery)	4,474	90	401	14 04
HOME ENTERTAINMENT	Radio	71	100	7	.25
	Radio/Record Player	109	83	9	.32
	Television black & white tube type	160	182	29	1.02
	solid state	55	181	10	.35
	color tube type	300	183	55	1 93
	solid state	200	183	37	1.30
HOUSEWARES	Clock	2	720	1.5	.05
	Sewing Machine	75	12	1	.04
	Vacuum Cleaner	630	6	4	.14

ENERGY CONSERVATION BULLETIN 3.4B.1
Buying Appliances

Intermountain Rural Electric Association 303 794 1535
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It's no longer enough to know the size, features, service and warranty you desire in an appliance. With the electric energy costs of today, and those forecast for the future, smart consumers will begin considering the life-cycle cost of major appliances . . . in particular, the operation costs, just as they do with automobiles.

WHAT ARE LIFE-CYCLE COSTS?

The life-cycle cost of a product is the total amount spent for and on a product during its usable life. This includes the initial purchase price; installation, maintenance, and service charges; and energy costs; less any trade-in value. Here are examples of life-cycle costs from a recent study furnished by the Association of Home Appliance Manufacturers:

*For a color TV with a life expectancy of 10 years, 53 percent of the life-cycle cost is in the purchase price, 12 percent is energy and 35 percent is service.

*For a refrigerator with a life expectancy of 14 years, the purchase price accounts for 36 percent of the total cost; energy, 58 percent; and service, 6 percent.

Energy cost differences, between the two can be explained by the fact the refrigerator is "on" almost constantly while the TV is using energy only at those times selected by the owner.

As you can see, with energy costs being a major expense during the life of the refrigerator, it makes good sense to purchase the most energy-efficient refrigerator you can afford.

HOW TO ESTIMATE LIFE CYCLE ENERGY COSTS

APPLIANCE	AVERAGE WATTAGE	ESTIMATED KWH USE PER YEAR ×	LIFE EX-PECT-ANCY ×	AVG. COST PER KWH =	ESTIMATED LIFE CYCLE ENERGY COSTS
Freezer, 15 cubic foot	341	1,195	20 years	.05¢	$1,195 for 20 years
Frostless, 15 cubic foot	440	1,761	"	.05¢	$1,661 for 20 years
Refrigerator 12 cubic foot	241	728	15 years	.05¢	$ 546 for 15 years
Frostless, 12 cubic foot	321	1,217	"	.05¢	$ 913 for 15 years
Electric Range with oven	12,200	1,175	12 years	.05¢	$ 705 for 12 years
Electric Range w/self-cleaning oven	12,200	1,205	"	.05¢	$ 723 for 12 years
Dishwasher	1,200	363	11 years	.05¢	$ 200 for 11 years
Automatic washer	512	103	11 years	.05¢	$ 57 for 11 years
Electric clothes dryer	4,856	993	14 years	.05¢	$ 695 for 14 years
Color TV (tube)	300	660	12 years	.05¢	$ 396 for 12 years
Color TV (solid state)	200	440	12 years	.05¢	$ 264 for 12 years
	160	350	11 years	.05¢	$ 193 for 11 years
B/W TV (solid state)	55	120	11 years	.05¢	$ 66 for 11 years
A/C (room)	860	860	12 years	.05¢	$ 516 for 12 years
Water heater	2,475	4,811	10 years	.05¢	$2,406 for 10 years

To use the chart, insert your average cost per KWH in column 5. Then multiply the KWH use by the number of years times the average KWH cost. This will give you a good idea of what it would cost you to operate an appliance with this wattage during its life cycle.

LOOK FOR THE "EER" OR ENERGY EFFICIENCY LABELS

It will pay to look for energy-efficiency labels on appliances when you shop. By 1980, all applicances will have an energy-use rating of some type attached to them at the point of sale. You can use them for comparison of models to make a wise purchase.

This labeling program is designed to help consumers shop for energy-saving household appliances and equipment. It is being developed by the Federal Energy Administration and the Federal Trade Commission as a result of the Energy Policy and Conservation Act, signed into law on December 22, 1975.

Under that law, manufacturers must place labels showing estimated annual operating costs on all models of the following:

- Central air-conditioners
- Clothes dryers
- Clothes washers
- Dishwashers
- Freezers
- Furnaces
- Home heating equipment not including furnaces
- Humidifiers and dehumdifiers
- Kitchen ranges and ovens
- Refrigerators and refrigerator-freezers
- Room air-conditioners
- Television sets
- Water heaters

Appliance testing, labeling, and public information procedures are currently being developed. You should be hearing about the appliance labels, as they become available in 1978 and 1979, through Government information programs.

For further information about the appliance labeling program, write the Federal Energy Administration, Appliance Program, Washington, D.C. 20461.

Currently, air conditioners carry "EER" labels. The EER is the energy efficiency ratio of the unit which has been determined by dividing the BTU-per-hour output by the electrical input in watts. The higher the EER number, the more efficiently the unit will operate.

Be prepared to pay a higher purchase price for a unit with a high EER; but over the usable life of the air conditioner, savings in cost of operation can more than balance the original price. Here's a comparison of two 12,000-BTU air conditioners, based on 12 years life expectancy at 5c per KWH.

Typical Cost	**A/C 1, EER 5**
Purchase Price	$210
Energy Cost	720
Service Cost	118
Life-Cycle Cost	$1048

Typical Cost	**A/C 2, EER 10**
Purchase Price	$255
Energy Cost	360
Service Cost	95
Life-Cycle Cost	$710

Refrigerators and freezers are harder to pin down in terms of energy efficiency, because the use (number of times the doors are opened, etc.), and features are a big determinant in how much electricity is used. However, monthly KWH-use estimates are available at point of purchase. Be sure to ask for them.

BE ENERGY-WISE IN PURCHASE AND USE

Along with figuring life-cycle energy cost estimates, comparing energy-efficiency labels, look also for specific energy-saving features on appliances. And, after delivery, be sure to read the use and care instructions furnished by the manufacturer. Learn to use your equipment properly; to do otherwise defeats the goal of wise energy use and can cost you dollars in service calls.

ENERGY CONSERVATION BULLETIN

Lighting

Intermountain Rural Electric Association 303 794 1535
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Explanation of Terms

Watts indicate the amount of electricity consumed by the bulb not the amount of light. The amount of light is measured in lumens. Carefully study bulb packages to get the most light per wattage.

Lumens are a measure of the quantity of light the bulb emits (two bulbs with the same wattage may differ in amount of lumens, or light actually emitted)

The **efficiency** of incandescent bulbs increases as the wattage increases. That means, for example, that you get more light from one 100-watt bulb than from two 50-watt bulbs, even though they use the same amount of energy.

Bulb life indicates approximately how long the bulb will last before burning out.

In General

•If you are presently using long-life or 130-volt extended service bulbs, changing to 120-volt standard bulbs of lower wattage will maintain your present light output at fewer watts and lower cost. Use long-life incandescent bulbs only in hard-to-reach places.

•We recommend using only 120-volt rated bulbs for most efficiency. By changing from a 100-watt, 130-volt bulb to a 75-watt standard life, you'll get nearly 4% more light and save kwhs (based on 12 hours per day use on 120-volt line).

•Instead of using overhead lights to light an entire room, try concentrating the light on the areas you'll be working in. This can be done with desk lamps, floor lamps, hanging lamps and pole lamps. If light is concentrated on work areas, in most cases you won't need as much light. It could be better for your eyes, too, when doing very close work.

•Use low wattage bulbs for decorative purposes, and higher wattages for such tasks as reading, sewing and other sorts of close work.

•Examine all light fixtures in your home to see if you are using more light than you need. You may find this especially true in hallways. If so, replace bulbs with those of less wattage.

•Use one large bulb in preference to three smaller ones where bright light is needed. A 100-watt lamp will provide better reading light than three 40-watt bulbs.

•Try 50-watt reflector floodlights in directional lamps (such as pole or spot lamps). These flood lights provide about the same amount of light as the standard 100-watt bulbs but at half the wattage.

•Try 25-watt reflector flood bulbs in high-intensity portable lamps. They provice about the same amount of light but use less energy than the 40-watt bulbs that normally come with these lamps.

•Normally this can be done without a loss of lighting level because the reflector bulb reflects more light out of the fixture into the room area. Also, there is less heat buildup which aids in longer life for the bulb.

•Turn off all but one or two low-watt lamps when watching TV. You only need enough light to balance TV brightness and avoid eyestrain.

•Use low-wattage night light bulbs. These now come in 4-watt as well as 7-watt sizes. The 4-watt bulb with a clear finish is almost as bright as the 7-watt bulb that uses about half as much energy.

Fluorescent Lighting

•Use fluorescent lights whenever you can; they give out more lumens per watt. For example, a 40-watt fluorescent lamp gives off 80 lumens per watt and a 60-watt incandescent gives off only 14.7 lumens per watt. The 40-watt fluorescent lamp would save about 140 watts of electricity over a 7-hour period.

The life of a fluorescent lamp is up to 10 times that of an incandescent lamp. With fluorescent lighting there's less heat build-up too.

•Consider fluorescent lighting for the kitchen sink and countertop areas. These lights set under kitchen cabinets or over countertops are pleasant and energy efficient.

•Fluorescent lighting also is effective for makeup and grooming areas. Use 20-watt deluxe warm white lamps for these areas.

•A 40-watt WWX (warm white deluxe) fluorescent lamp produces more lumens than a 100-watt incandescent bulb while consuming approximately half the energy. (Some wattage is consumed by the fluorescent lamp ballast).

100-watt incandescent bulb = 1,750 lumens
40-watt fluorescent WWX = 2,150 lumens

•Deluxe warm white fluorescent is recommended for home use because it produces the most pleasing color light that enhances food and facial complexions. Standard cool white tubes may be used in workshops and garages to gain more light output than the deluxe type.

•Turning off lights in unused rooms can result in savings. And contrary to some popular beliefs, turning a light on and off does not use more electricity than leaving it on. But in the case of fluorescent lighting, the life of the fluorescent tube is shortened about two hours each time it is turned off and restarted.

Other Tips

•Use daylight to its best advantage.

•Turn off all lights when not needed. There is no extra power used in turning a light on or off.

•Install light switches at each door in rooms with multiple exits to encourage turning off unneeded lights.

•Keep all bulbs and shades clean. Dirt absorbs light.

•You can save on lighting energy through decorating. Remember, light colors for walls, rugs, draperies, and upholstery reflect light and therefore reduce the amount of artificial light required.

•Consider three-way bulbs in reading lamps, etc. Three-way sockets can be easily installed into existing lamps at a nominal cost. Three-way bulbs provide a choice of lighting levels, high for seeing tasks, medium for less-demanding activities, low for safety. At low level, much less energy is used.

•Install dimmers where feasible. In dining, living and sleeping areas the use of dimmers can be an excellent aesthetic advantage as well as save energy. Action of the dimmer reduces the light level when higher amounts are not needed by lowering the flow of power to the fixture, thus saving electricty. A bonus — the bulbs will last longer, too.

•Use outdoor spots, floods and driveway illumination only when necessary.

•If you need outdoor lighting for safety and security, investigate low voltage systems. They use less energy and you can do the installation yourself.

•Install time clocks or a photocell unit on indoor/outdoor security lighting. That will prevent forgotten lighting from burning in the daytime. Also, the lights will work on schedule for additional safety while the family is away.

ENERGY CONSERVATION BULLETIN 3.6.1
Fireplace Use

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In today's home, the fireplace has two main functions. It is to look warm and inviting and to supplement the primary heating system. However, you should not count on your heating bills being reduced by burning wood in your fireplace when the furnace or other primary heat source is in operation. Most of the heat gained from the wood burning goes up the chimney plus an estimated 20 per cent of the warm air already in the home.

This is because the common fireplace in most homes today is only about 10 per cent efficient, even when well designed and constructed.
Significant modifications are possible however, that can increase this efficiency up to 50 per cent.

Combustion Air

A fire in a conventional fireplace requires large quantities of air for necessary combustion.

In a properly operating fireplace, between 500 and 600 cfm of combustion air will be drawn up the chimney. This occurs whether there is a roaring fire or a smoldering fire.

Unless special provisions are made, combustion air for a fireplace comes from inside the house. This may be air which was heated by a central heating system. It must be replaced by outside air if the fireplace is to operate properly.

Tightly constructed houses will normally average less than one complete air change per hour. For proper operation of a fireplace, there must be five or six air changes.

Several solutions address this problem:

•Install a vent for obtaining outside air if at all feasible or an air inlet grill in the hearth at the front of the fireplace to obtain combustion air from basement, crawl space or outside. If this isn't possible and if getting a proper draft is a problem, especially while starting the fire, slightly open the window nearest the fireplace.

•Closing off the room where fireplace is in use will reduce heated air from other rooms being drawn up the chimney.

Before firing up your fireplace, turn down any other heat in the room; set the thermostat at 60 degrees or lower.

If you really want to save money, only use the fireplace when all other heating systems are off. In mild weather conditions, little or no harm can be done by burning wood. Heat will be gained from the fireplace and the early fall and late spring chill can be elinimated.

Recovering Heated Air

•Build in a metal manufactured fireplace heat exchanger. One with a small fan for circulating the hot air increases efficiency.

•Without a heat recovery device the only heat realized from a fireplace is radiant heat. Most any type of wood or coal burning space heater would be four to five times more efficient as a supplementary heating unit.

A damper regulates the air flow or draft through the fireplace. The size of the damper opening should correspond to the size of the fire. Narrow for a little fire. Wide for a big one.

All fireplaces should have a full closing, regulating type damper. If your unit doesn't have a damper, one should be added as soon as possible. A built-in damper in a brick or stone fireplace will take some masonry work. Easier to install is a chimney top damper available for all type fireplaces.

Until a damper can be installed, a flat metal plate should cover the front as tightly as possible when the fireplace isn't being used. For easier handling of the plate, drawer handles and metal shelf brackets for feet may be added.

When the fire is dying out, keep closing the damper down as far as possible without causing smoke. But as long as there are hot coals, don't close the damper completely. At this time, you should also use the flat metal plate to cover the opening to greatly reduce the loss of heated air. When the fire is out, the damper has to be closed tightly to prevent the draft from stealing heat from the room.

•Every hour, an open damper can draw as much as 20 percent of the warm air from a room. It can also cause cold drafts near windows and doors. This causes the primary heating system to operate more often, causing your heat bill to be more expensive. So keep the damper closed until you use the fireplace again.

After some practice, you'll be able to fine tune the damper to pull a draft that will draw the most heat from the least wood.

•Install a glass door firescreen of clear tempered safety glass. This reduces heat loss up the chimney when fire is smoldering. Obviously, the flat metal plate isn't needed with this type screen.

•When using a glass screen, the fireplace should have an inlet for outside air. This is necessary for better burning and to prevent the loss of heated air from the room.

•While both wire mesh and glass screens offer looks and protection, the glass screens offer the bonus of saving energy.

In a properly constructed fireplace and chimney, there is an exact ratio between the dimensions of the fireplace and the size of the flue. A flue too small in proportion to the fireplace opening, will be too small for quality of smoke-laden air to be discharged. If the flue is too large, the draft will be diluted and cut down needed air current.

Downdrafts will cause a fireplace to smoke. Downdrafts can be caused by tall trees or buildings close to the house or by the chimney being too low in relation to the highest point of the roof.

The chimney top must not be less than two feet above the highest point. Adding a few courses of bricks may be the cure. A cap over the chimney or a weathervane hood also should be considered for preventing a downdraft.

The top of the chimney should be covered with a removable one-half-inch mesh screen as a spark arrester and to keep out birds. (Never consider using ordinary screen wire; it quickly clogs with soot.)

A metal or masonry hood over the chimney top will reduce the problem of rain and will help deflect the wind, which can cause smoking problems.

For safety and efficiency, the chimney should be kept clean. From the roof, pull a heavy chain up and down in[illegible]e the chimney. Or use a burlap sack filled with gravel [illegible]d to a long rope.

Leave about one inch of ashes in the hearth for insulation. The fire will start easier and burn better.

In most cases, starting the fire properly will send smoke up the flue. Always place the wood against the back wall of the fireplace. Also, while lighting the kindling, ignite a roll of newspaper and hold it high inside the fireplace opening to heat the air and produce a draft.

Once lit, keep the fire active and as far forward as possible without causing a smoking problem.

ENERGY CONSERVATION BULLETIN 3.7.1

Electric Heating Use

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Heating System Operation

•Heating and cooling our homes account for most of our residential energy costs. Don't waste any of that precious conditioned air.

It is a good idea not to change your thermostat constantly. Find a comfortable temperature and live with it. From a health standpoint it is better to have a lower temperature than a higher one. We generally recommend leaving the thermostat at 68° F. in the wintertime. Remember, it is better to wear warm clothing than to have a hot, dry house.

•If you do not have central heating in your home then it's a good idea to shut off unused rooms and close heating vents to these areas. But you should avoid closing off more than one-third of your house at a time. (This does not apply if you have a heat pump system. Leave it alone; shutting vents could harm a heat pump.)

•If you have ceiling heat never turn thermostat high for quick heat. The cable heats gradually and there's no way to make it go faster.

•Try to avoid using portable electric heaters. They pull a lot of wattage. If you must use them, place them in smaller areas where heat will be more confined. It takes too many such heaters to keep a large room warm. They are really best for supplemental heating. And keep them away from anything that could burn.

•When entertaining a large group during the heating season, it is wise to lower the thermostat a degree or two before guests arrive. People generate heat, and the room may become overheated, forcing you to open a window.

•During the winter months when the air in the house becomes dry from heating, it's smart to use a humidifier. The moisture that's given off by a humidifier is good for your furniture, plants, and for you, too. And by using a humidifer, the temperature can be kept lower without sacrificing comfort.

•Keep heat-producing objects such as lamps radios or TV's at least three feet away from the thermostat. These objects could emit enough heat to cause your thermostat to keep your home uncomfortably cool. A thermostat should also be located away from drafts so the furnace won't continue to run when the rest of house is warm enough.

•In arranging furniture, be careful not to block heating units. Drapes which cover heating registers or restrict air flow should be shortened. Baseboard heating units need air circulation in order to operate properly.

•Use heavy or insulated draperies, keep them closed at night, and fit them tightly at the top. In the summer and in warm climates, light colored curtains that you can't see through will reflect the sun and help keep your house cool.

•Keep doors and windows firmly shut and locked to cut down heat loss in winter and heat gain in summer. Check your windows and door latches to see whether they fit tightly and, if necessary, adjust the latches and plug any air leaks. You don't really need to open windows in winter — you usually get enough fresh air just from normal air leakage even if your house is well caulked and weatherstripped.

•When it's cold outside, draw the drapes over sliding glass doors and picture windows to create a heat barrier in front of these cold surfaces and reduce heat loss through conduction. If windows face the sun, leave them uncovered until the sun goes down.

•The tightest storm door in the world doesn't work when it's open — try to cut down the number of times that you go in and out. Adding a vestibule at your front and back doors will also help to tighten up your house.

Heating System Maintenance

•Keep those furnace filters clean. Checking them monthly is a very good habit to acquire. Your furnace always has to work harder when the air flow is restricted by dirty filters.

•Keep return heating air grills and warm-air ducts clean. Household dust and lint can overload your furnace, and clogged air ducts can keep a room from receiving sufficient heat.

•Clean your thermostat annually by removing the cover and carefully blowing away any dust which has accumulated.

•Check the duct work for air leaks about once a year if you have a forced-air heating system. To do this, feel around the duct joints for escaping air when the fan is on.

Relatively small leaks can be repaired simply by covering holes or cracks with duct tape. More stubborn problems may require caulking as well as taping.

•If the ducts for either your heating or your air conditioning system run exposed through your attic or grarage (or any other space that is not heated or cooled) they should be insulated. Duct insulation comes generaly in blankets 1 or 2'' thick. get the thicker variety, particularly if you've got rectangular ducts. If you're doing this job at all, it's worth it to do it right. For air conditioning ducts, make sure you get the kind of insulation that has a vapor barrier (the vapor barrier goes on the outside). Seal the joints of the insulation tightly with tape to avoid condensation. Check for leaks in the duct and tape them tight before insulating.

•On a Baseboard System, electric or hot water, once a year remove front covers. They usually snap out or have screws holding them on. Once removed, vacuum top, front, side and bottom, using a round brush so that you will not damage the fins. (Note: on electric system, make sure electrical switch is off.) Replace covers.

•Dust or vacuum radiator surfaces frequently. Dust and grime impede the flow of heat. And if the radiators need painting, use flat paint, preferably black. It radiates heat better than glossy.

•Once a year, all upright case iron radiators should be cleaned with a raditor brush. They should be cleaned lengthwise and then sideways. It is amazing how much dust radiators collect in a period of a year. Dust will restrict the flow of heat.

ENERGY CONSERVATION BULLETIN 4.1.1

How To Engage A Contractor

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If you prefer to hire an insulation contractor, you can find one by (1) asking your gas or electric utility company for suggestions, (2) consulting friends and neighbors, (3) looking in the phone book "yellow pages" under "Insulation Contractors — Cold & Heat" or a similar heading.

The next step is to call in two or three contractors to quote your job. You should judge quality as well as price. Here are some suggestions:

1. Check a contractor's realiability with the local Better Business Bureau (also listed in the phone book).

2. Ask a contractor for references, including other home owners for whom he has done work. Check them out.

3. Give all the contractors exactly the same outline of the job. For example, say, "I want to add R-19 to my attic floor," then stay with that specification and that way of saying it. Don't be satisfied if a contractor says, "OK, I'll add 6 inches."

4. Why not automatically be satisfied with 6 inches? Because not all brands of insulation have the same heat-retarding ability — 6 inches of one brand might not be the same as 6 inches of another. Stick with R-numbers. If a contractor won't deal with you in R-number language, don't you deal with him.

5. If a contractor is going to use blown-in insulation, how can you tell if you're getting R-19 performance, or R-22, or R-11 — whatever thermal resistance rating you decide you want? It's easy if you look at the bag lable. Federal government specifications, HH-1-1030A and HH-1-515B, require that each bag of loose fill insulation be labeled as shown below. If a contractor uses insulation packed in bags that aren't labeled, don't hire him; the quality of his material will be unknown.

R value	Minimum thickness	Maximum net coverage per bag
R-22	10"	45 sq. ft.
R-19	8-¾"	51 sq. ft.
R-11	5"	90 sq. ft.

The thicknesses and coverages shown on the bag label may be different for different manufacturers.

The coverage figure gives you a means of knowing how many bags of insulation the contractor should blow into your attic floor to achieve a particular R value. Multiply the overall square-foot area of your attic floor by .90 or .94 (see page 11 of this booklet), then divide that number by the "Maximum net coverage" listed on the label for the R-number you want.

When you talk to a contractor's salesman, ask him to show you the bag label for his brand of insulation and explain it to you. (When the job is being done, stay home and count the number of bags actually used.)

6. Ask a contractor how he pays his installers — by the square footage they cover or by the hour. If he pays them by square footage, they might do a hasty job on your house just so they can get on to the next one.

7. Ask a contractor about the insurance he carries. Does he have insurance to protect his own men if they are injured? Are you covered if one of his men damages your house — say, he steps through the ceiling?

8. **Insist on a written contract.** It should specify what the job covers, including the type and amount of insulation, its "R" value (see below), the cost and the warranty coverage. A contract that specifies the contractor's responsibility for cleanup and trash removal can save you a lot of grief.

9. Practically all insulating products are flammable to some degree, and some may emit dangerous levels of smoke and toxic fumes at high temperatures. Steer clear of anyone claiming that the products he uses are problem-free. For example, cellulose insulation should be treated to reduce flammability to an acceptable level, but improper treatment can reduce thermal resistance and cause corrosion of pipes and other metal items. Mineral wool (which includes rock wool and fiberglass) won't burn, but it may be enclosed in vapor barriers made of flammable paper. Sellers may say urea formaldehyde products are fireproof, but the Consumer Product Safety Commission says this is not so. Also not fireproof are "flame-resistant" polyurethane and polystyrene products, which can be used safely only if enclosed in a flame-and-heat-retardant structure, such as gypsum board. This is also advised for insulation products made of mineral wool, cellulose and urea formaldehyde.

Test methods for flammability in insulation established through the American Society of Testing and Materials (ASTM) check the rates at which various materials create smoke, permit flames to spread and contribute fuel to the fire. However, even products that meet "acceptable" criteria may still be flammable and should not be installed near heat.

- Be alert, says the Better Business Bureau, to these tactics:

claiming an "R" value for an insulation material that exceeds the general per inch range described in this booklet;

- representing the material as non-combustible, self-extinguishing or non-burning, unless proof of such a claim is provided.

- using scare tactics such as saying that your present insulation is "inferior" or that it may burn easily, just to make a sale.

- claiming they represent a utility company. Always check this type of claim directly with the utility company.

- claiming that you will qualify for federal, state or local tax relief by installing new insulation. Unless such laws have been passed, no salesperson can promise tax relief for installing insulation of any kind. Where tax relief does become law, then be sure that materials offered meet the prescribed conditions for eligibility.

- representing that the insulation is "approved by" the Federal Housing Administration (FHA) or by any other Federal agency, or by the Underwriters Laboratories, Inc. (UL).

ENERGY CONSERVATION BULLETIN 4.2.1
Heat Flow

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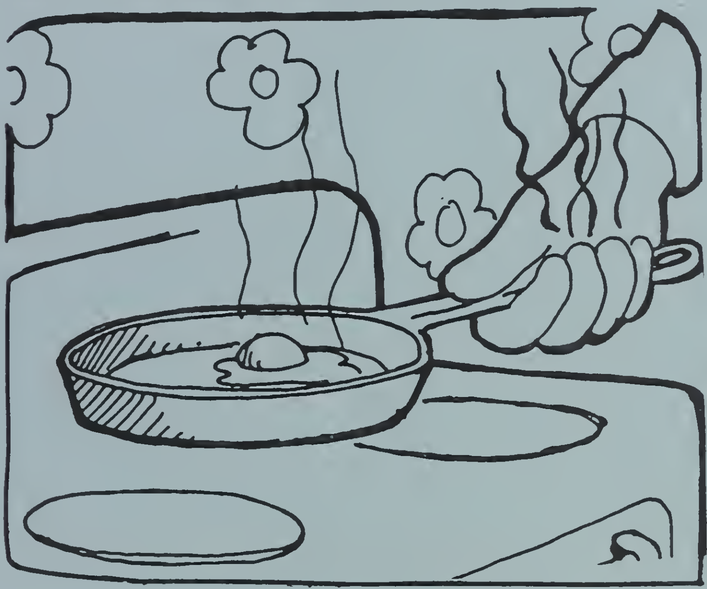
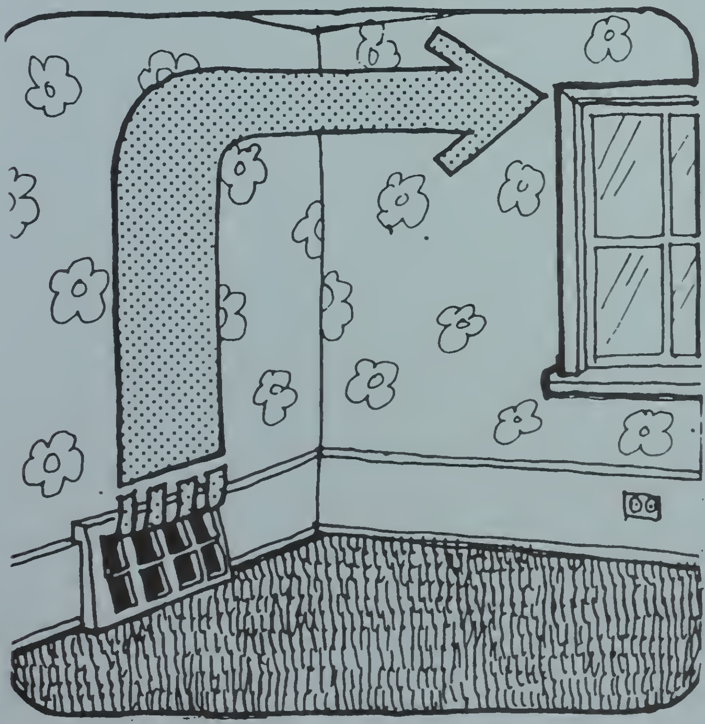
Heat flows via three separate processes:

1) CONDUCTION: Heat can be transferred directly from one part of an object to another part (as when the handle of a cast iron frying pan eventually gets hot). Similarly it can pass from one object to another (as when you try to pick up that frying pan). If one surface of the material is heated, the heat will be conducted through the material to the colder surface. The heat itself actually moves. Some materials, of course, will conduct better than others. Air is a relatively poor conductor of heat, though it does transmit heat by convection and radiation (see below).



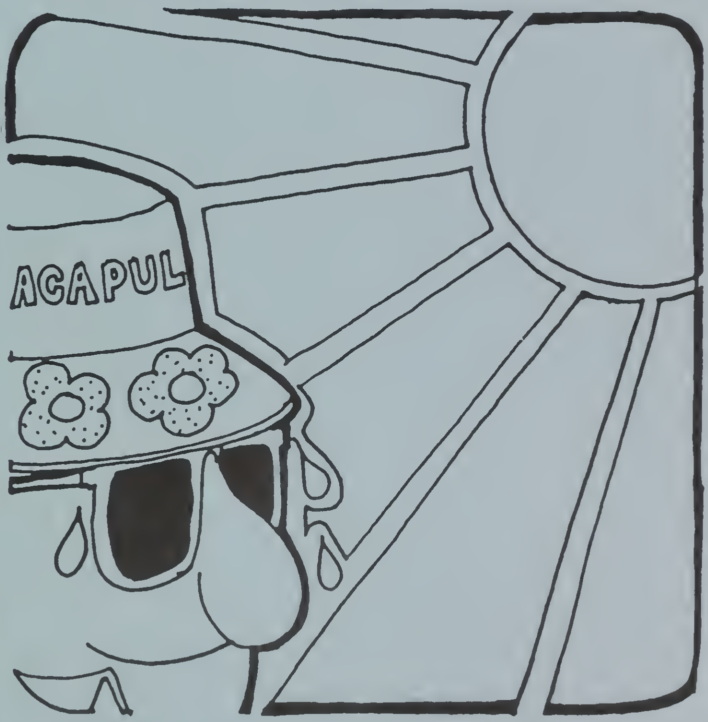
2) CONVECTION: Heat can also be transferred by the movement of heated material such as air. In an uninsulated wall space, for instance, air in contact with an inside wall will gradually heat up. Warm air rises, and the air in the wall cavity will begin to circulate. The warm air will come into contact with cold exterior walls, heat them up by conduction, and — bit by bit — heat is lost. At the same time, warm inside air may gradually filter through the wall to the outside — a further heat loss by convection.



3) RADIATION:

Heat loss by radiation occurs when there are two separate bodies or surfaces at different temperatures. The warmer body or surface will radiate heat to the colder body or surface without heating the air between them.

Thus any warm object will radiate heat in exactly the same way that the sun radiates heat — ''heat waves'' are given off. If you place your hand close to a light bulb, it feels warm — even though there is no air movement. Put a piece of paper between your hand and the light to block the waves, and your hand feels cooler. In an uninsulated wall space, a warm inside wall would radiate heat across the uninsulated space to the cold outer wall. More heat is lost.



Infiltration is warm air escaping to the outside and being replaced with cold outside air. This occurs by way of leaks around doors or windows, through open doors or windows, through cracks in walls, or up a fireplace chimney. Infiltration losses can be considerable.

ENERGY CONSERVATION BULLETIN 4.4.1
Reading And Understanding Utility Bills

2100 West Littleton Blvd **Littleton, Colo 80160**

Next time you receive a utility bill, spend a few minutes with it and make sure you understand what the charges are for. Compare it to bills for the previous month or for the corresponding month of the previous year, and see if your energy consumption has increased or decreased.

EXPLANATION OF TERMS

B.T.U.
The standard unit used in measuring the heat content of fuel. A B.T.U., or British thermal unit, is the amount of heat needed to raise the temperature of 1 pound of water 1° F.

Fuel cost adjustment:
A fee, also called a "pass-through," is added to an electric bill to compensate the company for the increased cost of the coal, gas, oil, or nuclear fuel from which it generates the electricity.

Watt:

The unit used in measuring amounts of electric power.

Kilowatt (KW) is equivalent to 1,000 watts

Kilowatt-hour:

Consumption of electricity is measured by the kilowatt-hour, which is the amount of energy delivered bv an hour long flow of 1 kilowatt of electric power. Your electric bill is based on the number of kilowatt-hours you use. (A 100-watt bulb burning for 10 hours will consume 1 kilowatt-hour of electric power—100 watts multiplied by 10 hours equals 1,000 watt-hours or 1 kilowatt-hour.)

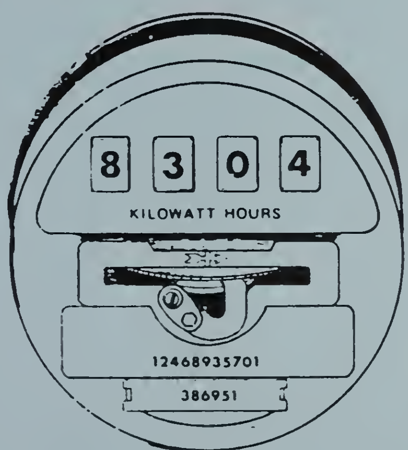
Here's how to read a meter:

Intermountain R.E.A. uses two kinds of meters. One is a digital meter in which numbers appear in little windows. The other is a dial meter, so named because it has dials rather than windows.

With the digital-type meter, simply record the numbers. In Figure 1, the reading would be 8304.

Figure 1:

DIGITAL TYPE

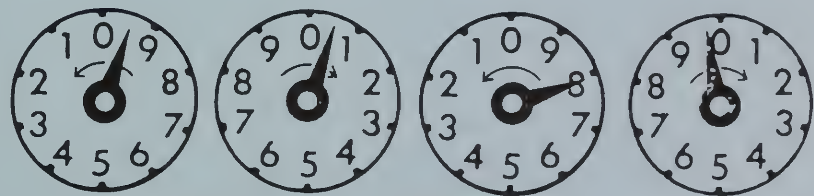


To find how much electricity you have used in the past 24 hours, subtract the previous day's reading from the present reading.

A few meters have a "multiplier" listed on the face. If the number is 1, then the kilowatt-hours used will be the difference between the two meter readings. If the multiplier is higher than 1, use that number to multiply the difference between the two readings to get the kilowatt-hours used. For example, if the difference between yesterday's and today's readings is 3 and the multiplier is 10, then you used 30 kilowatt-hours (3 x 10).

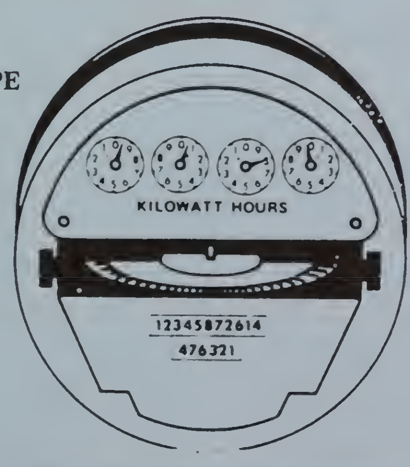
The dial-type meter has several clock-like faces. Reau number at which the left hand dial is pointing and write it down. Then read each of the remaining dials and write in those numbers. If an indicator is between numbers record the lower of the two numbers.

Examples: If the indicator is between 9 and 0, the lower number is 9. If the indicator is between 0 and 1, the lower number is 0. If the indicator points directly at a number, you should check to determine whether that number or the next lower one should be recorded. Use the number at which the indicator is pointing if the indicator of the dial to the right is between 0 and 1. However, if the indicator of the dial to the right is between 9 and 0, then record the number below the one at which the indicator is pointing. The meter shown in figure 2 reads 9079.



(Figure 2.

DIAL TYPE



METER MONITOR CHART

END OF MONTH READING ______________ KWH USAGE ______________

AMOUNT OF BILL ______________

$\frac{\text{AMT}}{\text{KWH}}$ = ¢/KWH (average cost per KWH) ______________

Note: To obtain daily KWH usage, subtract previous day's reading from current day's reading

Daily Reading	KWH Used Daily	KWH Weekly
1		
2		
3		
4		
5		
6		
7		
Weekly total		
8		
9		
10		
11		
12		
13		
14		
Weekly total		
15		
16		
17		
18		
19		
20		
21		
Weekly total		
22		
23		
24		
25		
26		
27		
28		
Weekly total		
29		
30		
31		
Extra Days Total		
MONTHLY TOTAL ——————→		

Monthly Total KWH Usage × Average Cost Per KWH = Estimated Bill

______________ × ______________ = ________

Budget Cushion ________

Budget Figure ________

It's really best to begin your readings on the "meter reading" or the "service to" date noted on your last electric bill. By subtracting the previous day's reading from the current day's reading, you obtain the number of kilowatt-hours (KWH) used during the 24-hour period. By adding the daily figures into a weekly total, and the weeks into a monthly total, you can begin to see how much electricity your family uses monthly and how this usage fluctuates with family activities.

The daily reading may be about the same for several days and then shoot up. When this happens, ask yourself . . . "What was different about that day?" Perhaps it was cooler or hotter than usual, requiring heating or cooling equipment to work harder? Perhaps you had visitors? With more people around, refrigerator doors as well as entry doors are opened and closed more often . . . more lights, food preparation and entertainment appliances are in use.

When your electric meter shows more power being used, there's a reason for it. It's up to the Sherlock Holmes in your family to find it. . .and monitoring the meter gives you the first clues for the search. Once you know your family's electrical-usage patterns, you can then make value judgments as to what conservation practices best fit your lifestyle.

ENERGY CONSERVATION BULLETIN 4.5.1

Why Conserve

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

Almost all of us believe to some degree in conservation. For some people, it is a simple matter of saving money; for others, a husbanding of resources now so that we will not find ourselves short in the future. For yet other poeple, conservation represents an ideal, a way of life to which we should aspire. Whichever is your view, there are many sound reasons to support energy conservation as an important new direction for our energy policy. Let us focus briefly on just the most obvious of these.

First, there is the sheer physical volume of energy that is being demanded in a world of ever more people, of higher incomes, and of more technology. With every increase in our rate of consumption, it becomes harder to find, produce and transport the necessary energy materials. For the first time, we are in a position where projected future demands levels cannot be satisfied by conventional energy sources. Without conservation, oil and natural gas shortages may bring the energy situation to a critical stage unless uncertain nonconventional or potential frontier resources are developed and delivered in sufficient quantity — and we can't depend on that. Even future electricity supply is not assured. Feasible hydro sites are now almost totally developed and high quality uranium reserves are limited.

Second, even if we could locate energy resources of suitable quantities and qualities, their costs would be monumental.

This effect gets worse with time because, as we move to lower quality and more remote sources of energy, it will cost us more and more money and energy to obtain energy. The costs continue to rise!

The impact of this on our economy will be severe, both in terms of inflation and because it means fewer dollars for housing, schools, hospitals and industrial projects.

Third, assuming the resources were available and could be produced at a cost that we were willing to pay, to produce them and then consume them would involve large-scale environmental impacts.

Obviously, by conserving energy, the environmental impacts of production, transportation and use of energy can be avoided. Energy conservation can be viewed as the purest form of environmental protection.

In view of the resource and cost factors, conservation offers a low-cost and low-risk alternative to continued high-demand growth.

Finally, let us examine the idea of quality of life. This is perhaps an over-used phrase, but the fact that it is overused means that, for many people there is a feeling that our higher incomes and greater wealth have not been producing all that we had hoped that they would. For example, we now have larger, more powerful automobiles, but it takes us just as long to get to work and there are even more aggravations on route. Our luxurious homes are burgeoning with appliances, our garbage bags burst with waste from the affluent society. But has all this consumption and convenience brought us closer together — or has it alienated us from the natural world and from each other?

There is sound evidence to think that most indications of quality of life have begun to turn downward. We once thought that the "good life" was closely related to our energy consumption. It now seems that efforts at moderating that consumption — smaller cars, more mass transit, better built houses, less waste production, more personal involvement — will contribute to the quality of life at the same time as they save energy.

Home Comfort

— A well insulated house is a comfortable house! In winter, the interior surface of an uninsulated wall can be 4 to 8 Celsius degress (8 to 14F°) cooler than an insulated wall. Most people don't realize that body heat will radiate to the cold walls, ceilings, or floors, at a rate uninfluenced by the room temperature. We feel cold, and may even turn up the thermostat, thereby using even more fuel. Insulation overcomes this "cold wall effect."

—These same cold surfaces will cause drafts. Air adjacent to them will be cooled, and so increase in density. It will settle, displacing warm air. Insulation acts to prevent this. At the same time, weatherstripping and caulking also act to cut down on other drafts.

—During the summer, insulation will keep a house cooler. In effect, the insulation is keeping the heat from the sun out.

— Most forms of insulation also act as sound insulation. Storm windows and doors keep noise out as well.

ENERGY CONSEVATION BULLETIN 4.6.1
Frame House Construction

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

The vast majority of houses are referred to as "wood frame" constructions. Put simply, this means that the structural framework is made largely of wood. The exterior may be brickwork, stucco, wood, steel, aluminum, or numerous other finishing materials while the interior will most often be plaster or drywall. Nevertheless, the structural support and strength derives from the wooden frame hidden behind the surfacing. This chapter outlines the basics of this kind of construction.

There are a number of other possible constructions for a house. Solid masonry (brick, stone, or concrete) or solid wood are the most common.

As mentioned, however, wood frame houses are a very substantial majority in this area. Fortunately, they are readily re-insulated.

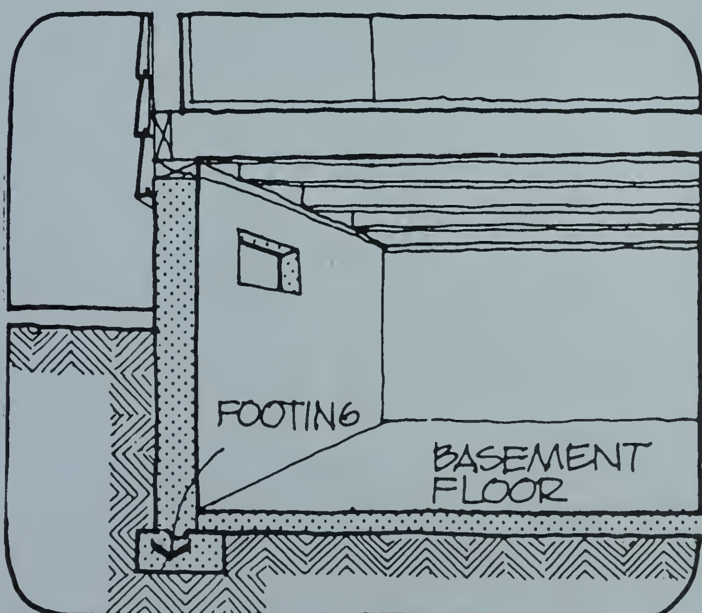
Solid construction houses are more difficult, but not impossible. If you are unsure about how your house is built, there are a couple of ways to get a look into the wall. In many houses, the wall construction can be seen from the attic. If not, it may be necessary to poke a small hole in the wall finish. This should be done in an out-of-the-way place, such as the back of a cupboard. If you damage the vapor barrier make sure you repair it before re-sealing the hole.

It is important to have an understanding of how a typical wood frame house is built. Details will vary from house to house, but the general principles are as follows:

Basement Foundation

Foundations are normally made of concrete, concrete blocks, or stone.

Houses with basements set upon a footing (usually

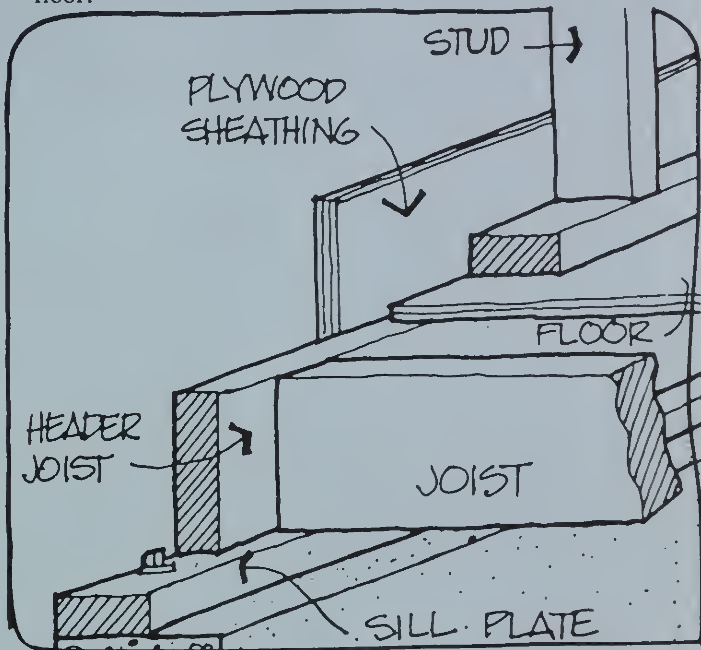


concrete) as illustrated. Few homes of this sort have any basement insulation at all.

Houses without basements most often have a foundation similar in principle. Insulation is often applied against the footing on the outside of the house.

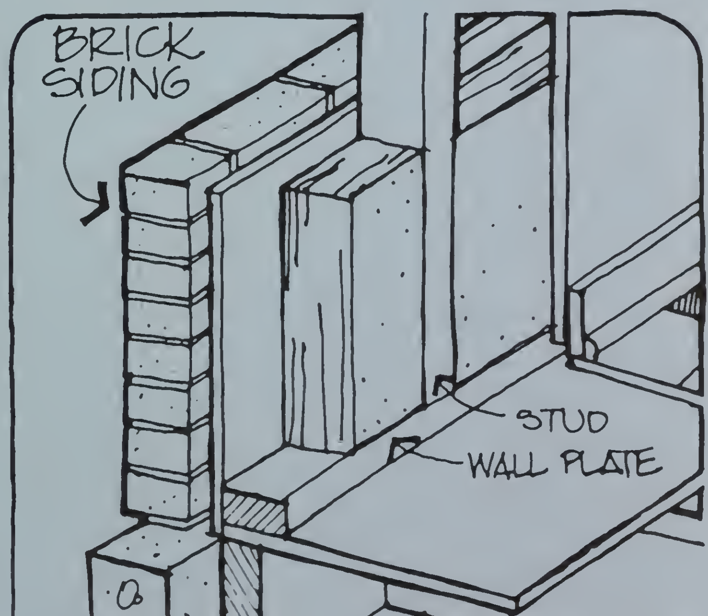
Walls

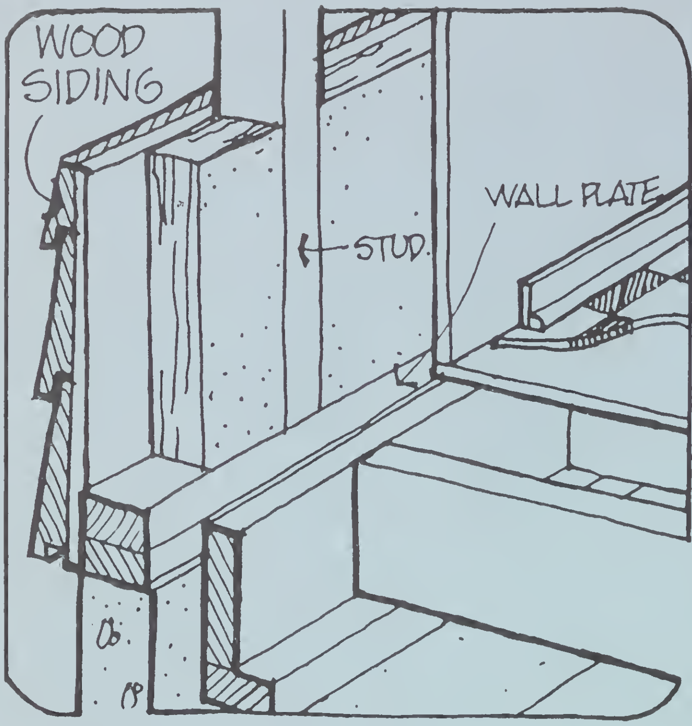
The junction between the foundation and the walls varies greatly, but the diagrams in this section represent a few typical formats. The "sill plate" is anchored to the foundation in order to support the "joists" and the "header joist." These in turn support the walls and the floor.



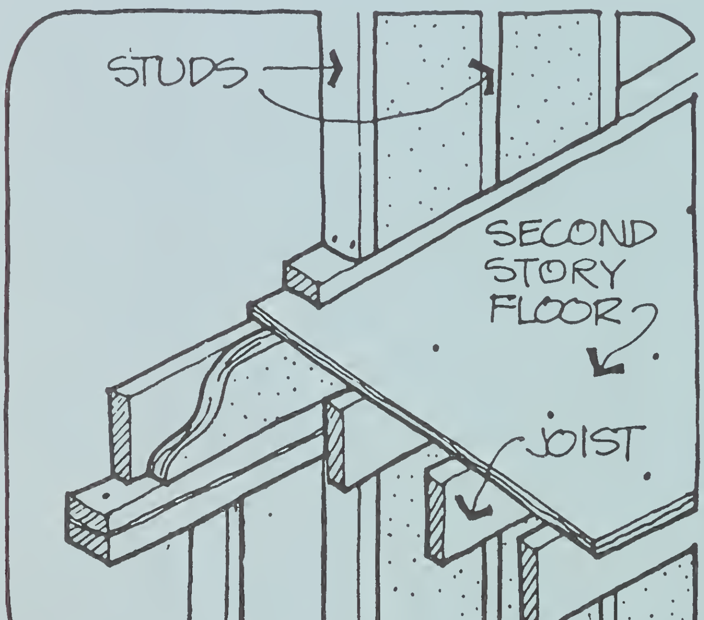
The "wall plate" supports vertical wooden "studs," usually 2" x 4" or 2" x 6". Except in the vicinity of windows and doors, these studs are uniformly spaced, usually 16" or 24" apart. The stud space is where wall insulation is normally placed.

The inside and outside finish is attached to the wood frame in a number of ways, as illustrated. Notice that in each case the finish, though protecting the structural parts of the wall from the elements, contributes only slightly to the strength of the structure.





In most 2-story homes, the junction between 1st and 2nd floors is constructed as in the diagram. Of necessity, insulation should be applied in the 3 spaces indicated: the 1st floor walls, the 2nd floor walls, and the space between the 2 floors.

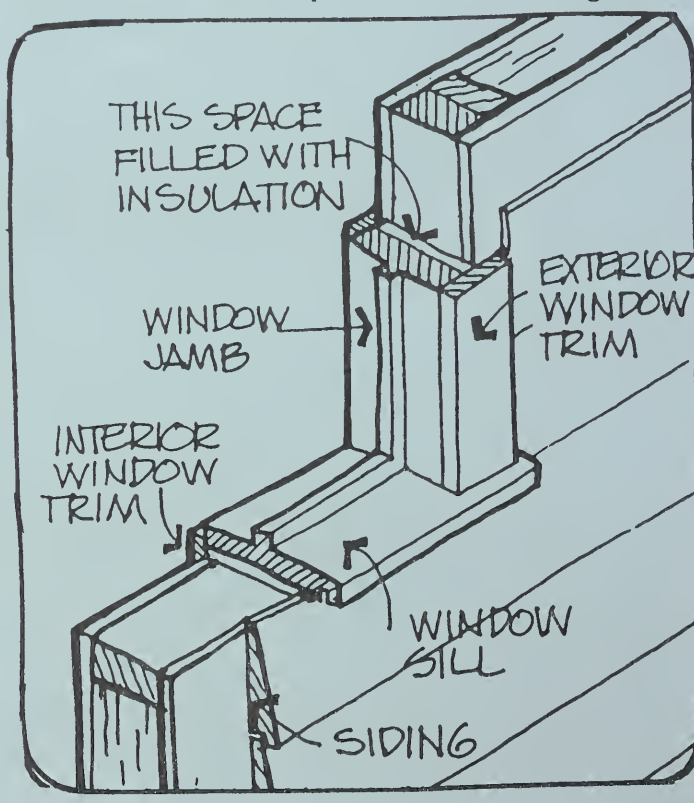


Some walls in 2-story houses are constructed differently, such that the stud space runs continuously from the foundation to the attic. In such a case the insulation should also be continous. In other instances, the stud space may be broken up at irregular intervals by wooded crosspieces (used as fire-breaks). Insulation must be applied in all the stud spaces that this creates.

Windows and Doors

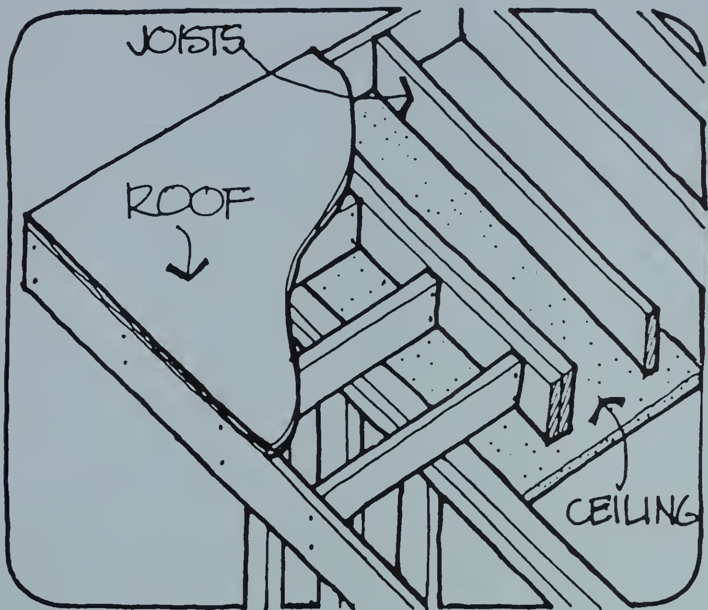
Around windows and doors, the stud space may become irregular. Framing is generally done as shown, with the space allowed for the window being slightly oversize.

Precise fitting is then achieved using small pieces of wood (spacers) to position the actual window frame. Insulation must still be applied to the irregular stud spaces, as well as to the tiny openings around the door or window which result from the framing. These thin spaces cannot be insulated except when the wall is being built.

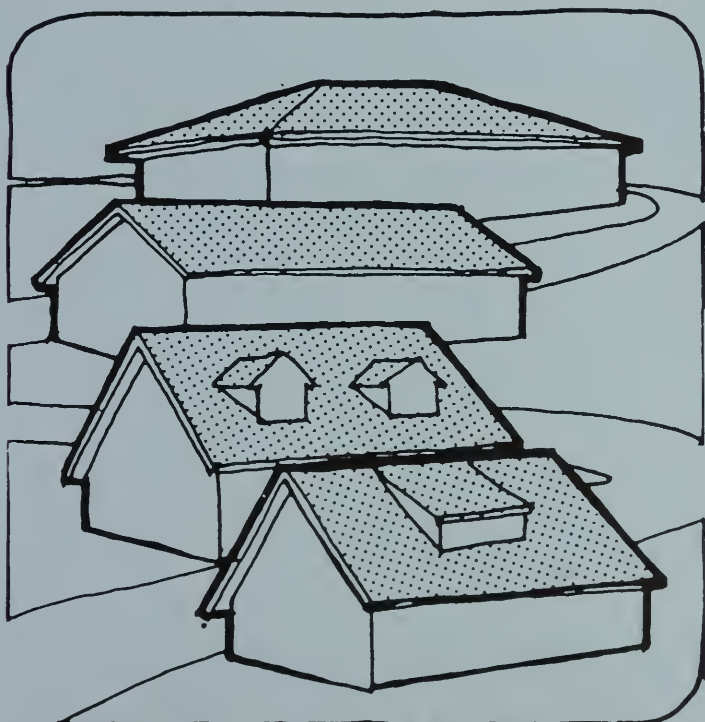


Ceiling and Roof

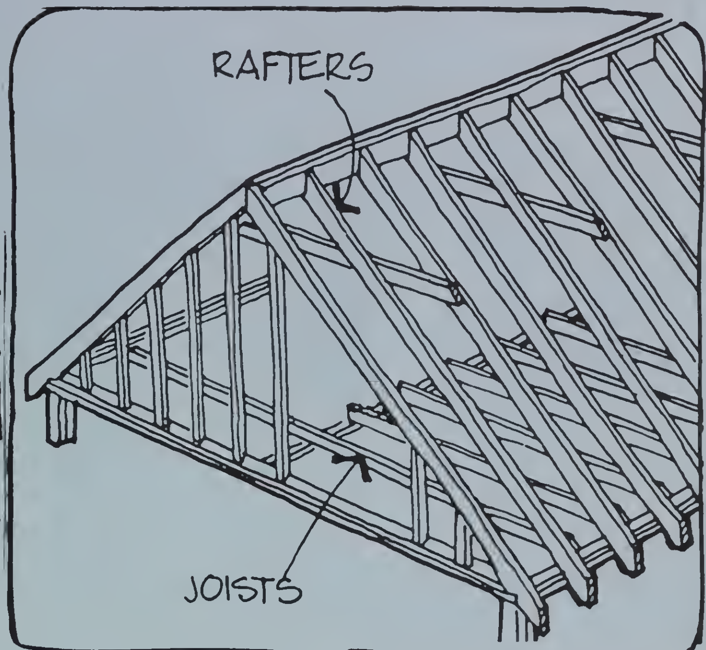
Flat roof homes are commonly constructed as illustrated, with both the ceiling and roof attached to opposite sides of the same joist. Insulation may be applied between the roof and ceiling, or on top of the entire construction.



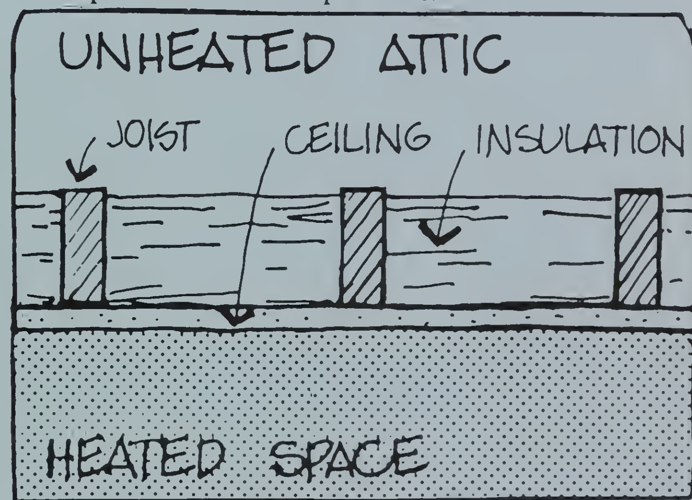
The more common styles with sloping roofs (a few are illustrated) are framed somewhat differently. The ceiling



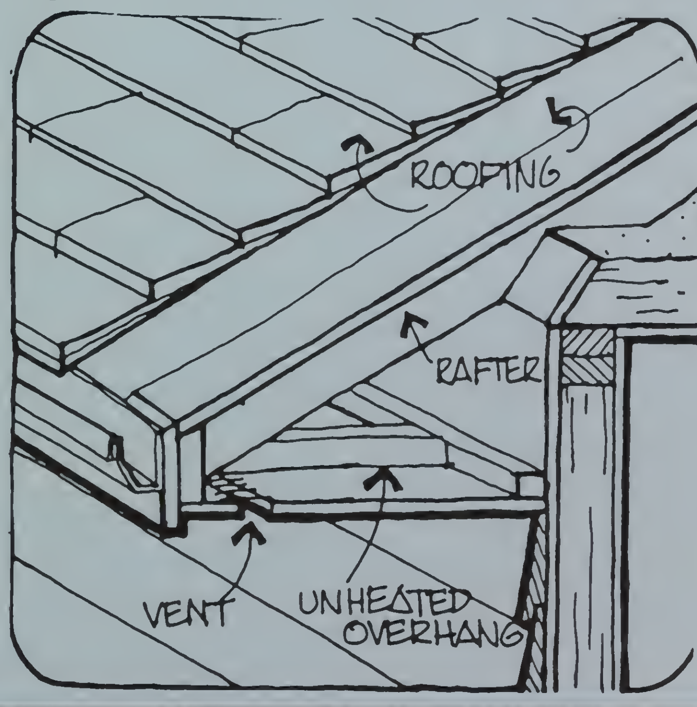
material is attached to the lower joists, while the "rafters" support the roofing material.



The insulation is laid between the joists, so that the heat is kept out of the unoccupied attic.



The rafters usually extend beyond the exterior wall of the house, leaving an unheated, uninsulated overhang space.



ENERGY CONSERVATION BULLETIN 5.1.1

New Homes

Intermountain Rural Electric Association 303 794 1535
2100 West Littleton Blvd Littleton, Colo 80160

If you are planning a new home, you can add to its comfort and enhance its salability, even while saving considerable energy and money.

By investing in a few energysaving features, you can cut the heating and cooling costs to well below those for a comparable house built to the standards of 1974 or earlier.

Usually when you build, you intend to stay awhile. (Even if you plan to move, an energy efficient home should be worth more.) Savings of $300 to $500 a year in energy bills mount up quickly and you can recoup the extra expense in a few years. After that, you are ahead financially.

Energy savings can be made through the design of the house and by taking care in its orientation on its site. South-facing windows can be solar collectors in winter and can be shielded from the sun in summer by an overhang that varies in width with latitude. On other sides, windows should be held to the minimum size needed for daylight (an energy saver) and for views.

Savings can be made by locating living areas on the south and east sides, bedrooms on the north. Doors can be insulated and have automatically closing storm doors. For frequently used doors, vestibules are an old idea whose time has come back.

Positioning the house to counteract or take advantage of prevailing winds is another of the many complex functional factors that must be fitted together in designing an energy efficient home. Combining these with an attractive result is a job for an architect.

If you can find an energy-oriented architect, his contributions and supervision can be worth much more than his fee. However, many architects today may be challenged to satisfy a client who makes a strong demand for an energy-efficient home.

An interesting idea worth looking into is the passive solar home. One kind has no solar panels. The structure takes maximum advantage of solar orientation for heat gain in winter and removes any excess daytime heat and stores it in a slab or sand bed under the house, from which it radiates upward. A heat pump provides basic heating and air conditioning.

Another idea: Instead of the usual 2-by-4-inch studs, use 2-by-6-inch ones. That will allow 5½ inches of insulation in the walls. Add an inch of rigid plastic insulation under the siding and you achieve better than R-19, now recommended for walls in practically all of the U.S.

The use of 2-by-6-inch studs entails little or no ext lumber expense since they are set 24 inches apart instea of 16 inches. The added insulation is worth the cost. necessary, you can afford the insulation by postponing th purchase of something else.

Comfort systems for a new house

Selecting the kind and capacity of heating and coolin systems for a new or remodeled house is a job for experts All of your energy-saving features should be factored int the calculations to give you the least capacity that will d the job.

If you don't have an architect to do this, choose contractor who will make a detailed analysis of your needs or one who has access to a manufacturer's computer for a analysis of your specifications, climate, energy prices i your area and other conditions.

- Consider a square floor plan. It usually is more energy efficient than a rectangula plan.
- Insulate walls and roof to the highest specification recommended for your area.
- Insulate floors, too, especially those over crawl space cold basements, and garages.
- Install windows you can open so you can use natural o fanforced ventialtion in moderate weather.
- Use double-pane glass throughout the house. Window with doublepane heat-reflecting or heat-absorbing glass provide additional energy savings, especially in south and west exposures.
- Consider solar heat gain when you plan your window locations.

  In cool climates, install fewer windows in the north wall because there's little solar heat gain there in wint

- Install louvered panels or windpowered roof ven tilators rather than motor-driven fans to ventilate the attic. Only use a motor-driven fan if it can be used for wholehouse ventilating during cool periods.

Kitchen Layout

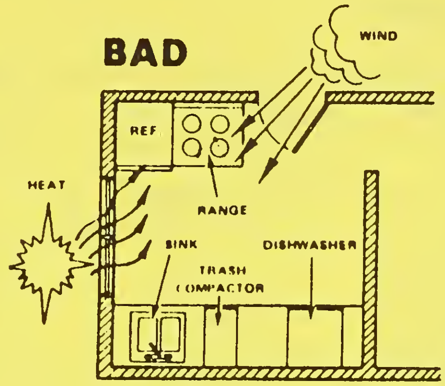
When improving or remodeling a kitchen, built-in energy conserving measures may substantially reduce the amount of energy needed to operate appliances and may even represent an investment with long term savings in operating costs.

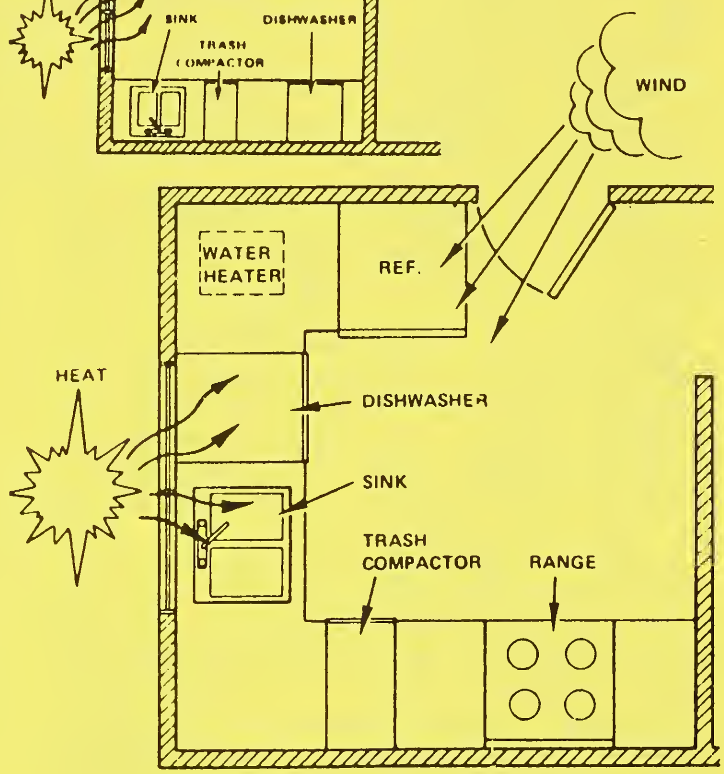
According to experts, consider carefully the best location for each appliance. Kitchen appliances are commonly grouped according to the function they will serve. If possible, three separate areas should be established for food storage, preparation and clean up, and cooking.

Install the refrigerator-freezer and separate freezer away from windows, radiators and heat producing appliances. Locate refrigeration appliances in a level, dry, cool, well-ventilated area. Make certain there is a level, dry, space behind and above the units to allow adequate air circulation to the condenser. Refrigerator condensers are located either directly behind or underneath the units. More space should be allowed behind the unit if the refrigerator has a back-mounted condenser.

Locate the range in an area away from refrigeration equipment where a vent fan can be installed to draw excess heat directly to the outside in the summer. To minimize room heat loss in the winter and heat gains in the summer, check your kitchen for air leaks. Weather strip and insulate windows and doors. For example, a gap of ¼ inch at the base of a normal 36 inch wide door equals a 9 square inch hole in the side of your house.

BAD





GOOD

If You Buy An Existing Home

Few homes built even in recent years have insulation that meets today's requirements. Before you buy a house, you should try to assure yourself that it has at least a minimum. Some sellers won't know what's in their house; others will avoid a commitment, especially in writing. A few will be able to produce bills for insulation or show you what's in the attic.

The bottom line is in the actual fuel energy bills for the house over the past year — not selected months.

Ask to see the utility bills from the previous year but remember to adjust them for current utility rates.

You can see whether the house has double glazing or storm windows, tell generally how well its doors and windows are weatherstripped and if cracks are caulked. Even some new houses don't have insulation in the exterior walls. Be sure to check. But adding insulation and storm windows could be substantial outlays. If improvements are necessary, you may want to seek an adjustment in the purchase price to cover all, or a reasonable share, of the costs.

If you are not knowledgeable about building details, then it might be wise to have an architect or heating and air conditioning contractor look at the house before you make a final decision. He will evaluate a lot more for you than its energy performance.